The Canadian Mining Review

Established 1882

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The Canadian Mining Review
Established 1882

Official Organ of The Mining Society of Nova Scotia; The General Mining Association of the Province of Quebec; The Asbestos Club; and the Representative Exponent of the Mineral Industries of Canada.

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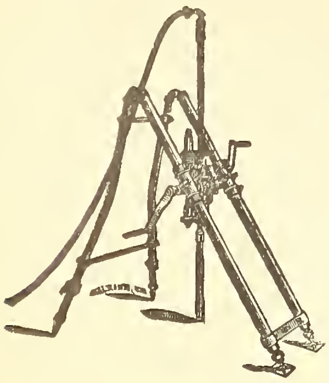

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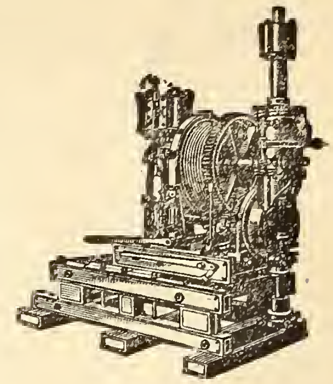

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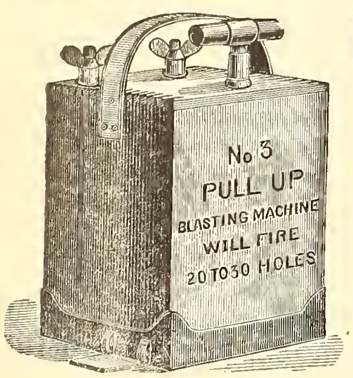

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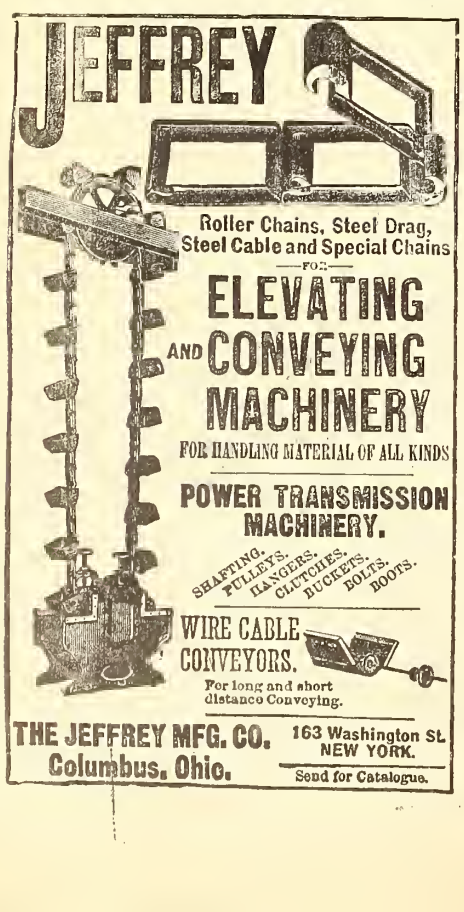

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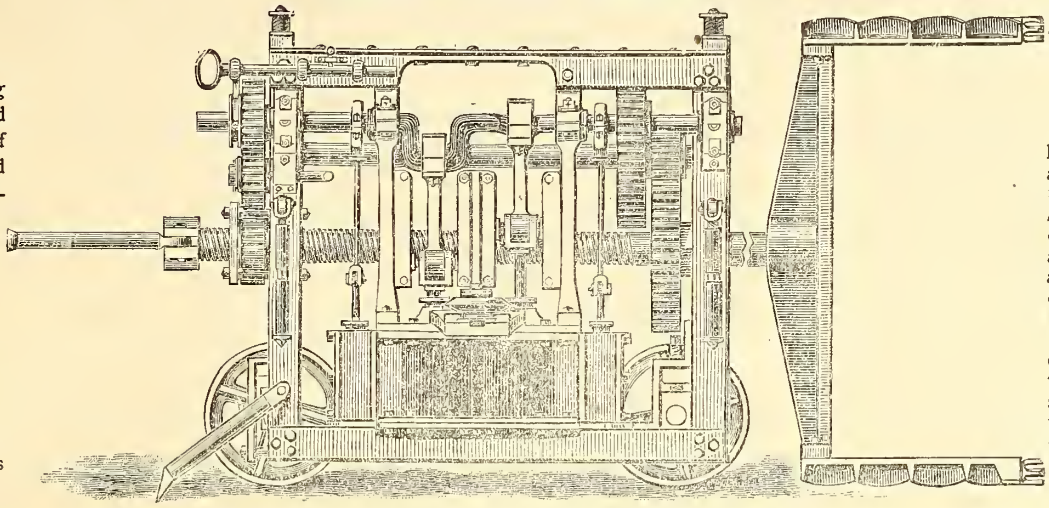

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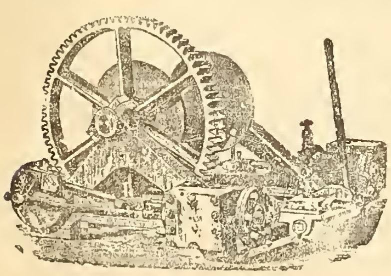

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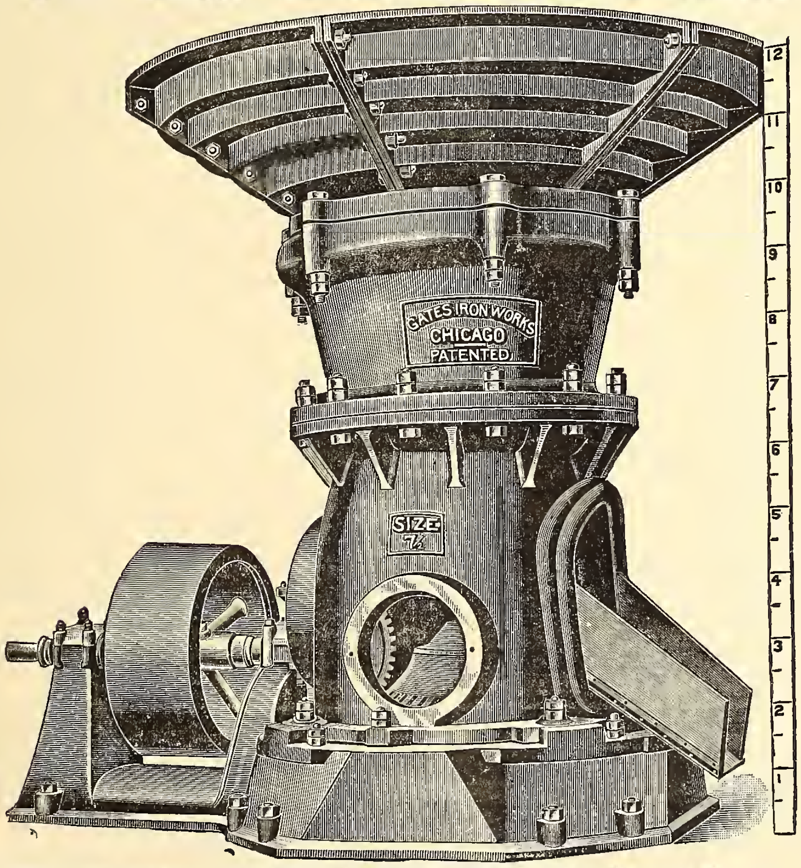

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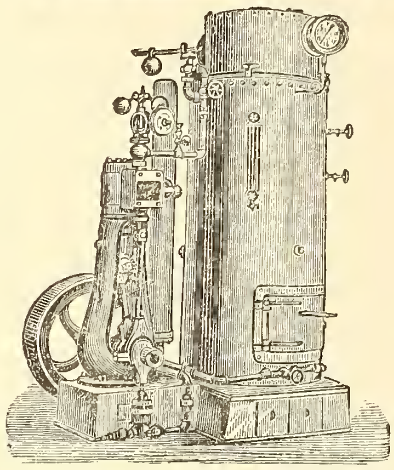

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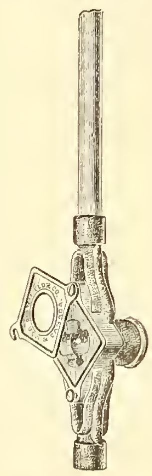

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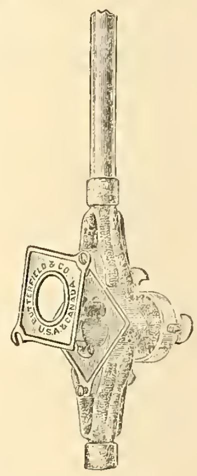

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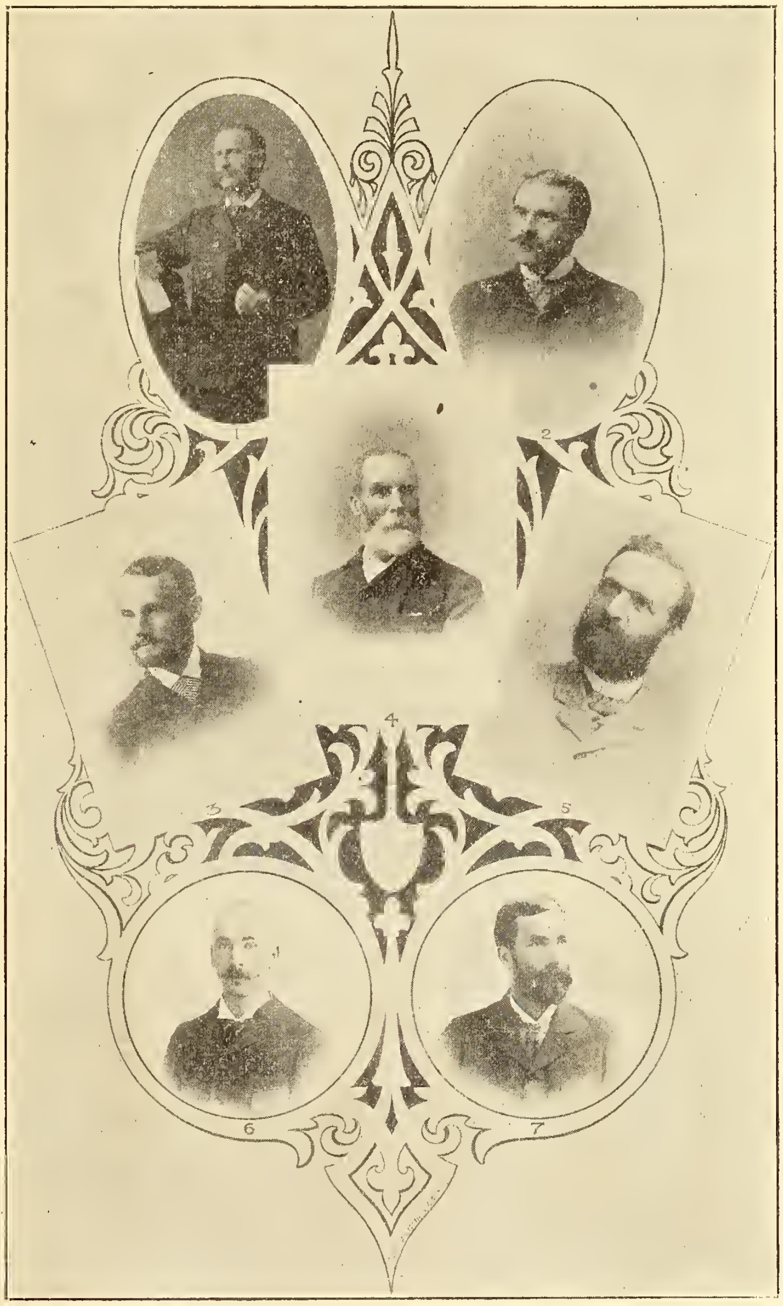
B. T. A. BELL, Editor. Published Monthly. OFFICES: Victoria Chambers, Ottawa.

VOL. XIV., No. 1. JANUARY, 1895. VOL. XIV., No. 1.

Kingston School of Mining.



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General Mining Association of the Province of Quebec.

Many new members elected. Students affiliated. Federation. Quebec Coal Trade, 1894. The Mining Industries of Quebec reviewed. A large number of valuable papers presented.

Fifth Annual Meeting.

The Fifth Annual General Meeting of the members of the General Mining Association of the Province of Quebec opened on Wednesday morning, 9th January, in the New Club Room, Windsor Hotel, Montreal, Mr. John Blue, C. & M. E. (Eustis Mining Co.), President, in the chair. There was a large attendance, among others the following:—

Mr. J. S. Mitchell (Beaver Asbestos Co., Ltd.), Sherbrooke.
Mr. H. A. Budden (Intercolonial Coal Co., Ltd.), Montreal.
Mr. W. J. Nelson (Intercolonial Coal Co., Ltd.), Montreal.
Mr. John J. Drummond (Canada Iron Furnace Co., Ltd.) Radnor Fuges.
Mr. S. L. Spafford (Nichols Chemical Co.), Capelton.
Mr. John J. Penhale (United Asbestos Co., Ltd.), Black Lake.
Mr. D. D. Mann (Victoria Hydraulic Gold Mining Co.), Montreal.
Mr. P. A. Patersen, C.E. (Horsefly Hydraulic Mining Co.), Montreal.
Mr. John B. Hobson, M.E. (Horsefly Hydraulic Mining Co.), Quesnelle Forks, B. C.
Mr. J. M. Browning (Cariboo Mining Co.), Vancouver, B.C.
Mr. T. Drummond, M.E. (Cariboo Mining Co.), Montreal.
Mr. George E. Drummond (Canada Iron Furnace Co., Ltd.), Montreal.
Mr. George R. Smith (Bell's Asbestos Co., Ltd.), Thetford Mines.
Mr. John E. Hardman, S.B., M.E. (Pres. Mining Society of N.S.), Halifax.
Dr. James Reed (Harvey Hill Copper Mines), Reedsdale, Que.
Mr. Theodor Boas (Jeffrey's Asbestos Mine), St. Hyacinthe.
Mr. Dwight Brainerd (Hamilton Powder Co.), Montreal.
Mr. R. T. Hopper (Anglo-Canadian Asbestos Co., Ltd.), Montreal.
Mr. A. W. Stevenson, C.A. (Treas. G.M. Association, Que.), Montreal.
Mr. F. P. Buck (Dominion Lime and Marble Co.), Sherbrooke.
Mr. E. B. Haycock (Star Gold Mines), Ottawa.
Mr. W. H. Nichols, jr., M.E. (Nichols Chemical Co.), New York.
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Mr. S. P. Franchot (Emerald Phosphate Co.), Buckingham.
Capt. Robt. C. Adams (Anglo-Canadian Phosphate Co.), Montreal.
Mr. A. McNicholl (Gen. Pass. Agent Can. Pac. Railway), Montreal.
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Mr. W. A. Carlyle, Ba. Sc. (McGill University), Montreal.
Dr. Frank D. Adams (McGill University), Montreal.
Mr. F. C. Innes (Montreal & B.C. Mining and P. Co.), Vancouver.
Mr. C. W. Spencer (Supt. Can. Pac. Railway), Montreal.
Mr. Frank Grundy (Gen. Manager Quebec Central Railway), Montreal.
Mr. W. F. Dean (Can. Genl. Electric Co.), Montreal.
Mr. J. T. Dwyer (Carriere Laine & Co.), Levis.
Prof. B. J. Harrington (McGill University), Montreal.
Mr. Walter Adams, Ba. Sc. (Peto Company), Montreal.
Mr. J. Fraser Torrance, M.E., Montreal.
Mr. F. Cirkel, M.E., Ottawa.
Mr. A. Macdonald, St. John's, Que.
Mr. J. Keitth Reid, M.E., Montreal.
Mr. H. Lockwood, Beauce.
Mr. Judge Brooks, Sherbrooke.
Mr. W. S. Gardener (Mach Supply Co.), Montreal.
Dr. A. R. C. Selwyn, C.M.G. (Geol. Survey of Can), Ottawa.
Mr. J. C. Gwilliam, Montreal.
Mr. J. M. Turnbull, Montreal.
Mr. R. A. Gunn, Ba. Sc., Montreal.
Mr. G. F. Burnett, Montreal.
Mr. C. H. Taylor, M.E., Montreal.
Mr. Moses Parker, Montreal.
Mr. W. M. Webb, Montreal.
Mr. R. H. Stewart, Montreal.
Mr. W. S. Johnstone, Montreal.
Mr. W. M. Mussen, Montreal.
Mr. F. Rutherford, Montreal.
Mr. G. Hillary, Montreal.
Mr. E. E. Van Barnweld, Montreal.
Mr. O. C. Hart, Montreal.
Mr. R. Green, Montreal.
Mr. J. W. Bell, Montreal.
Mr. R. W. Dougall, Montreal.
Mr. H. N. Thompson, Montreal.
Mr. F. W. Angee, Montreal.
Mr. W. Askwithe, Montreal.
Mr. F. Wilkin, Montreal.
Mr. W. E. Archibald (Sec. McGill Mining Soc.), Montreal.
Mr. B. T. A. Bell, Editor Can. Mining Review, Ottawa, and others.

The meeting was called to order at eleven o'clock, when the minutes of previous meetings were read and confirmed.

The Secretary's Report.

MR. B. T. A. BELL—Notwithstanding exceptional commercial and industrial depression which, unfortunately, has not been without effect upon the mineral industries of the Province, it is gratifying to be able to report that the past year has been in many respects one of the most successful in the history of the Association.

The meetings have been well attended, the excursions full of interest and enjoyable in the extreme, while the numerous papers presented cover a wide field and have been instrumental in increasing knowledge of the art of mining and in spreading valuable information respecting the mining industries and mineral resources of the province and of the country.

By the death of Col. Lucke we have again to lament the loss of a popular officer, and one who took a deep and energetic interest in all its affairs. The startling intelligence of the sudden and untimely event was received during the excursion to Cape Breton, and was a sad interruption to the enjoyment of the members. A meeting was convened on board the steamer, and a resolution entered in the minutes recording appreciation of his services, and expressing most tender sympathy with his widow in her bereavement.

At the Sherbrooke meeting, Mr. W. A. Allan, Ottawa, was unanimously elected to the vacant Vice-Presidency.

Meetings were held at Montreal on 11th and 12th January, when four sessions were held: on board the steamer "Bonavista," en route to Cape Breton on the evenings of 6th and 9th July; and at Sherbrooke on 26th and 27th September.

During the year twelve papers were considered, as follows:—

(1) "The Diamond Prospecting Drill in Mining Canadian Apatite and Other Irregular Deposits," by Mr. J. B. Smith, Glen Almond.

(2) "Mine Tunnels and Tunnel Timbering," by Mr. W. A. Carlyle, Montreal.

(3) "Notes on the White Mica Deposits of the Saugenay District, (Que.," by Mr. J. Obalski, Quebec.

(4) "On the Igneous Origin of Certain Ore Deposits," by Dr. F. D. Adams, Montreal.

(5) "The Canadian Iron Industry," by Mr. George E. Drummond, Montreal.

(6) "Ore Sampling," by Mr. J. T. Donald, Montreal.

(7) "The Silver Mines of West Kootenay, B.C.," by Mr. E. D. Ingall, M.E., Ottawa.

(8) "Slate: Its Formation, Extraction and Uses," by Mr. Harry Williams, Thetford Mines, Quebec.

(9) "The Magnetic Needle," by Mr. A. W. Elkins, Lennoxville, Que.

(10) "Repairs to Rock Drills," by Mr. A. Sangster, jr., Sherbrooke.

(11) "Chrome Iron; Its Properties, Mode of Occurrence and Uses," by Mr. J. T. Donald, Montreal.

(12) "The Occurrence of Chrome Iron in the Province of Quebec," by Mr. J. Obalski, M.E., Quebec.

As will be seen, these have been presented by three honorary and seven ordinary members, six of whom have contributed before.

A very notable feature of the year has been the interesting character of the excursions held under the auspices of the Association. By kind invitation of Mr. David McKeen, M.P., Resident Manager of the Dominion Coal Co., Ltd., Mr. R. H. Brown, General Manager of the General Mining Association Ltd., and the officers and members of the Mining Society of Nova Scotia, a delightful and instructive holiday was spent in Cape Breton, visiting the collieries and other important features of that beautiful and historic island.

The programme included:—

An excursion by water to the various shipping piers on Sydney Harbor of the Dominion Coal Company, Ltd.

An excursion by special train to the Bridgeport, Dominion No. 1, International and Caledonia Mines of the Dominion Coal Company, Ltd.

An excursion by water to the Old Sydney Mines of the General Mining Association, Ltd.

An excursion by water to the historic port of Louisburg.

A drive to the Coxheath Copper mines.

The members were entertained to a public banquet at Sydney by Mr. David McKeen, M.P., and to a luncheon by Mr. R. H. Brown at his residence at Sydney Mines.

The cordiality of the reception accorded to the Association by the officers of the various companies and the local authorities was such as is likely to be long remembered by those members who were present. The local committee, comprising Mr. McKeen, Mr. Brown, Mr. Blakemore and Mr. Archibald, made the most thoughtful, complete and satisfactory arrangements for the comfort and entertainment of our party, and special acknowledgment is due to them and to Messrs. Kingman Brown & Co., agents of the Black Diamond Line, for special rates and excellent accommodation provided for the round trip on their steamer "Bonavista."

The Autumn Meeting was held at Sherbrooke in September last, for the second time in the history of the Association, and was one of the most successful, alike as regards attendance, the number and importance of the papers and the thoroughly enjoyable character of the excursions. At Capelton our members inspected the extensive underground works of the famous Eustis Mine, and were entertained with characteristic hospitality by our esteemed President and his good lady, Mrs. Blue.

Our hearty acknowledgment is also due to Mr. Frank Grundy, General Manager of the Quebec Central Railway, for his courtesy in placing a special train at the disposal of the members for the excursion on the following day to the Dudswell Quarries and the chromic iron and asbestos mines on the line of his railway. A thoroughly enjoyable evening at the hospitable residence of the Hon. W. B. Ives, Q.C., M.P., where the members were entertained to dinner, concluded the proceedings of this meeting.

The question of consolidating the existing Mining Societies into an united organization was discussed at our last annual meeting, but inasmuch as the mineral rights are vested in the local governments and mining is carried on in the Provinces under widely different conditions and laws, it was thought advisable to preserve the autonomy of the Societies as they now exist, and a proposition to federate was substituted. The objects in view were three-fold:—

(*a*) Economy in publication.

(*b*) The consideration of such matters affecting or relating to the mining industries of the Dominion as might be within the jurisdiction of such an organization.

(*c*) The holding of a United Meeting once a year.

Mr. F. A. Halsey and the Secretary were delegated a committee to bring the matter before the Mining Society of Nova Scotia, and this was done at the annual meeting of that organization in March, when it was referred to a committee to report at a later meeting.

In the following April, the Ontario Mining Institute, a representative organization of the mineral interests of that Province, was formed, and on the question being submitted to it, federation was endorsed and a committee appointed to co-operate with the other Societies in drafting a scheme. The desirability of the step was further agreed upon at a united meeting of the members of all three Societies held at Sydney, Cape Breton, in July. As the outcome of further discussion at our Sherbrooke meeting, a committee comprising the President, Messrs. F. A. Halsey, L. A. Klein and the Secretary, drafted a scheme which, with minor changes, was approved by the Ontario Committee. Both reports were then submitted to the Mining Society and considered at a meeting in November, when certain radical amendments were introduced which it will be the duty of this meeting to consider.

Early in the year a complete volume of the transactions for the years 1891-92-93 was issued to members, and the heavy cost of this publication has been a serious drain upon our finances. The Hon. E. J. Flynn, Commissioner of Crown Lands, with commendable enterprise and foresight, purchased fifty copies for distribution among the principal mining institutions and Public Libraries of Europe and the United States, where it is hoped the information will bear fruit in directing attention to our mineral resources and mining industries. Copies were also purchased by the Hon. W. B. Ives, President of the Privy Council, and the Hon. T. M. Daly, Minister of the Interior. The revenue from these sources was of great assistance.

In view of the importance to the country of a thorough education of Canadian students in mining and metallurgy, the establishment of a course of mining engineering and the magnificent equipment of the Science Departments of McGill College have been a source of gratification to every one interested in Canadian mineral development. With the object of placing such advantages as the Association may offer, within easy reach of the students attending these classes, there has been some correspondence respecting a student membership, or as an alternative, the affiliation of the McGill Mining Society, and a proposition will be submitted for the approval of the members at this sessions It has also occurred to me that our appreciation of the good work that is being accomplished might take a still more practical form if we offered a medal or a money prize for annual competition among the students for contributions from them to our proceedings.

The Mining Act, the law respecting the storage of powder, and the question of the free importation of mining machinery. subjects that occupied considerable prominence in the operations of the Association in previous years, having all been adjusted more or less to the satisfaction of the Association, there was no action on matters of legislation during the year.

The following comparative statement of the affairs of the Association since its organization to date, is respectfully submitted :—

MEMBERSHIP.

	Active.	Hon.	Total.	New.	Resigned.	Dead.
1891—	52	5	57	--	—	—
1892—	46	5	51	7	12	2
1893—	76	13	89	36	5	1
1894—	78	20	98	18	15	1

	Meetings.	Papers.	Deputations.	Excursions.
1891—	4	7	2	—
1892—	3	8	3	1
1893—	6	22	2	2
1894—	3	12	—	3

	Receipts.			Disbursements.		
	Ordinary.	Special.	Total.	Ordinary.	Special.	Total.
1891—	$510 00	—	$510 00	$311 20	—	$311 20
1892—	618 80	—	618 80	402 38	—	402 38
1893—	906 42	$1,500	2,406 42	726 19	$1,543 36	2,269 55
1894—	650 00	482	1,268 87	1,291 22	--	1,291 22

	Balance Credit.	Balance Debit.
1891—	$198 80	— —
1892—	216 42	——
1893—	136 87	——
1894—	--	$22 35

Financial Statement.

Mr. A. W. STEVENSON submitted balance sheet for the year, showing the income received to have been $1,268.87, with a number of members' subscriptions outstanding. The expenditure included :—Printing, $655.88 ; engraving, $41 ; Secretary's grant, $150 ; Secretary's disbursements and expenses, $197.56 ; Treasurer's disbursements, $58.45 ; stenographing, $71.90 ; dinners and luncheons, $106.43 ; or a total outlay of $1,291.22. The amount charged to engraving was properly chargeable to current year, and when all outstandings were collected there would be a fair balance in favor of the Association.

THE PRESIDENT—Considering that we have had an unusually heavy disbursement on account of printing, the Treasurer's statement is very satisfactory.

Both reports were then adopted.

Student Membership.

On motion of the Secretary a new clause, among others, was inserted in the Constitution, as follows :—

"Student members shall be persons who are qualifying themselves for the profession of mining, metallurgical or mechanical engineering, or other branch of engineering, and such persons may continue student members until they attain the age of twenty-five years. They shall have notice of, and the privilege of attending, all meetings and excursions, and shall have all the privileges of the Association except voting.

"Student members shall pay an annual fee of one dollar."

Medals to Students.

A clause was also inserted whereby power was given to award annually a sum not to exceed fifty dollars, in the form of medals, or other awards, to student members, for original papers contributed to the proceedings of the Association.

New Members.

The following were elected active members :
Mr. H. A. Budden (Intercolonial Coal Co.), Montreal.
Mr. Huntley Drummond (Cumberland Ry. & Coal Co.), Montreal
Mr. F. A. Routh (Carbray & Routh), Montreal.
Mr. T. B. Brown (Kingman, Brown & Co.), Montreal.
Mr. N. A. Belcourt, Q.C. (Wallingford Mica Co.), Ottawa.
Mr. T. F. Nellis (Vavassour Mining Association), Ottawa.
Mr. G. L. Burritt (Ingersoll Rock Drill Co.), Montreal.
Mr. Walter Fleming (Reddaway & Co.), Montreal.
Mr. Louis Gendreau, Jersey Mills, Que.
Mr. D. D. Mann (Victoria Hydraulic Gold Co.), Montreal.
Mr. J. M. Browning (Horsefly Hydraulic Mg. Co.), Montreal.
Mr. C. Berkely Powell, Ottawa.
Mr. C. H. Taylor, M.E., Montreal.
Mr. J. S. Palmer, Sherbrooke.
Mr. F. C. Innes, Vancouver.
Mr. Thos. Drummond, M.E., Montreal.
Mr. G. H. Bradford, Sherbrooke.
Mr. W F. Dean (Can. General Electric Co.), Montreal.
Mr. J. T. Dwyer (Carriere Laine & Co.), Montreal.
Mr. W. H. Nichols, jr., M.E., New York.
Mr. Moses Parker, Montreal.
Mr. Louis Chouillou, Montreal.
Mr. G. F. Burnett, Montreal.

Student Members.

The following were elected student members :—
Mr. R. A. Gunn, Ba. Sc., Montreal.
Mr. J. C. Gwilliam, "
Mr. W. M. Webb, "
Mr. R. H. Stewart, "
Mr. W. S. Johnstone, "
Mr. W. M. Mussen, "
Mr. O. C. Hart, "
Mr. F. Rutherford, "
Mr. G. Hillary, "
Mr. E. E. Van Barnweld, "
Mr. O. C. Bart, "
Mr. R. Green, "
Mr. J. W. Bell, "
Mr. R. W. Dougall, "
Mr. H. N. Thompson, "
Mr. F. W. Angel, "
Mr. W. Askwith, "
Mr. F. Wilkin, "
Mr. W. E. Archibald, "

Election of Officers and Council, 1895.

President :

Mr. John Blue, C. & M.E. (Eustis Mining Co.), Capelton.

Vice Presidents :

Capt. Robt. C. Adams (Anglo-Canadian Phosphate Co.), Montreal.
Mr. S. P. Franchot (Emerald Phosphate Co.), Buckingham.
Mr. G. E. Drummond (Canada Iron Furnace Co.), Montreal.
Mr. F. P. Buck (Dominion Lime Co.) Sherbrooke.

Treasurer :

Mr. A. W. Stevenson, C.G., Montreal.

Secretary :

Mr. B. T. A. Bell (Editor Canadian Mining Review), Ottawa.

Council :

Mr. Jas. King, M.P.P. (King Bros.), Quebec.
Mr. L. A. Klein (American Asbestos Co.), Black Lake.
Mr. John J. Penhale (United Asbestos Co.), Black Lake.
Mr. George R. Smith (Bell's Asbestos Co.), Thetford Mines.
Mr. H. A. Budden (Intercolonial Coal Co.), Montreal.
Mr. J. S. Mitchell (Beaver Asbestos Co.), Sherbrooke.
Mr. J. Burley Smith (British Phosphate Co.), Glen Almond.
Mr. C. H. Carriere (Carriere, Lainé & Co.), Levis.
Mr. R. P. Hopper (Anglo-Canadian Asbestos Co), Montreal.

Federation.

The Council having considered the report of the Mining Society of Nova Scotia, on the question of a federation of existing Canadian mining societies, reported the following recommendations :

Governing Board.

(*a*) That the clause "The qualification for full membership shall be an annual fee of ten dollars, etc.," be deleted.

(*b*) Be changed to read : "The Council shall elect a Chairman and a Secretary-Treasurer each year, the latter to receive such remuneration as may be determined by the Council."

Subscription.

Be amended to read : "The Societies in the federation shall each pay an annual subscription towards the expenses of the Institute, of such an amount as may be determined upon at each annual meeting ; but the contribution from each Society shall at no time exceed in amount the sum of three dollars *per capita.*"

Publications.

Be amended to read : "Publications of the Institute shall be supplied only to members in good standing in their respective Societies, one copy to each member, and the balance shall be sold by the Council at such prices as may be determined.

"Contributors of papers shall be entitled to 20 copies of a reprint of any paper presented by them and published by the Institute.

"Copies of the Proceedings sent for exchange shall be accompanied with a request for such exchange for each society in the Federation."

The Secretary reported that these recommendations would receive the indorsation of the Ontario Mining Institute.

On motion, the suggested amendments were unanimously agreed to, and the Secretary was instructed to forward them to the Mining Society of Nova Scotia for reconsideration.

The meeting adjourned at one p.m.

Afternoon Session.—Notes and Statistics respecting the Mineral Industries of the Province of Quebec during the Year 1894.

The members reassembled at two p.m., the President in the chair. The hall, as at the morning session, was crowded. The first item was the consideration of a series of reports on the mineral industries during the year.

Notes on the Pig Iron Trade of 1894.

Mr. G. E. DRUMMOND.—The year 1894 is not likely to go down to history as a year of unparalleled success in the iron trade of the world. In common with nearly all other leading industries, that of iron has been working on "rough ground." In the United States, now the leading iron market of the world, the shadow of the panic year of 1893 seems to have darkened every avenue of Trade and Commerce, and not least of all the Iron industry. The exhaustion, following on so severe a shock, of itself prevented any very rapid recuperation at the commencement of the year. At the commencement of 1894 the outlook was gloomy enough, and as the year wore on it brought with it a long series of troubles calculated to prevent reviving confidence and enterprise.

Among the difficulties referred to, the depletion in the government gold reserve, beginning in January, led to enormous issues of bonds, which of course went to prolong the season of depression. Then the coal and railway strikes, and finally the great uncertainty of the tariff question. This combination of adverse circumstances all tended to bring about an unparalleled shrinkage in values, effecting everything in the iron line, from the raw material to finished product, and of course served to restrict the purchasing ability of the people.

New and economic methods of production were introduced wherever capital permitted, but withal the work from the first has been unprofitable to capital and labor. Many works have been kept in operation simply to keep the men employed, even if at what a year or two ago would be called "starvation wages."

Despite all this the feeling of hopefulness has never died out, and for instance, at the close of the year the output of pig iron in several districts reported, shows an increase over the production of 1893, with many more furnaces in operation.

There is a more hopeful feeling abroad, brought about in a great measure by the result of the recent elections in the United States, and 1895 opens with numerous enquiries from consumers, who are not unlikely to be good buyers in the near future. While the experience of the last two years in the iron trade, and in fact in all other trades in the United States has not been a pleasant one, yet the enforced "breathing spell" is not unlikely to prove a blessing in disguise. Great economy has been practiced in all branches of trade, and this must result in good. For instance, the railway companies have been so economical that their rolling stock has run down to a great extent, and they must very soon come into the market as large buyers. When they do, the whole tone of the iron trade will be strengthened, and it is hoped that capital and labor will be able to earn at least a fair return.

The course of the British iron market during 1894 was marked by the great strike among the Scotch coal miners, which lasted for several months, beginning in July and not coming to an end before October. It appears to have been altogether uncalled for, and did not awaken the public sympathy as did the English coal strike of the previous year. The result, however, was that the Scotch iron trade was brought almost to a standstill while it lasted, and it will be a long time before the loss of trade can be made up. For over three months hardly a furnace was in blast in Scotland, but owing to the fact that the great proportion of the foundries, rolling mills, and other consumers of pig iron were also idle for want of coal, the local demand for iron was light, and prices did not advance to any appreciable extent. Warrants remained stationary about 42/- to 43/- and the closing price on 31st December was close on 42/-. The effect, however, on special or shipping brands of iron was to advance the price of these about 5/- to 7/6 per ton, owing to their scarcity. No. 1 "Summerlee" was sold as high as 58/6 in Glasgow, the highest point it has touched for the past two years. Several brands were entirely unobtainable. It shows that the Scotch market no longer controls the iron trade of the world, for such a scarcity happening ten or twenty years ago would have sent prices up to an alarming extent. As it was, however, the production and consumption of iron for 1894 shows a large decrease on the previous year, the figures being as follows:—

Official returns show that the Scotch pig iron production

in 1894 was	655,614 tons,
as against in 1893	783,867 "
a decrease of	128,253 tons.

The consumption also shows a decrease, and whilst taking all British made iron into calculation, the consumption only fell 41,657 tons behind that of 1893, yet the decrease in the consumption of Scotch iron, owing probably to the strikes and consequent high prices of coal, was 125,657 tons.

STOCKS.—At the close of 1894 the stock in Connell's store

amounted to	287,886 tons,
as against in 1893	320,851 "
a decrease of	32,965 tons.
Stock in makers hands at the close of 1894	70,713 tons,
as against at the close of 1893	60,936 "
an increase of	9,777 tons.

English irons, that is those made in the Middlesboro district, remain almost unchanged, and a large quantity finds its way into Scotland.

Bar iron and manufactures of mild steel, such as plates, angles, etc., have remained practically unchanged during the year, but owing to the quiet state of trade, prices closed a few shillings lower than the opening figure of the year. The change that has come over the trade in these goods is very marked. A few years ago almost the entire requirements of the country in mild steel, and all the bar iron that was not produced in this country, came from Great Britain. During the year just ended the importations of these goods from Great Britain were practically nothing. Prices on the American side have been forced down, by keen competition, to such an extent that all the steel plates, and the great proportion of the angles and other shapes now come from Pittsburgh, at prices which the English manufacturer cannot touch.

CONTINENTAL IRON TRADE.

The same general features of restricted production and consumption, brought about by the depression in trade, obtains in the iron markets of Germany, Sweden, France and Belgium, with the exception that the returns from Belgium evidence an increase in the output, although the consumption has been unsatisfactory.

CANADA.

In sympathy with the condition of the iron trade elsewhere, the Canadian iron industry has felt the depression in some degree. The battle over the tariff question that was fought at Ottawa throughout the winter months, and had the effect of retarding the progress of the industry, and it may be safely claimed that the first half of the year was, to a certain extent, lost in uncertainty.

Happily the Dominion Government decided that the industry should be encouraged. This restored confidence, and the iron masters took up the work promptly. The effects, however, of the depression in the United States had a very marked effect on the trade of the last six months of 1894. The overstocks of the American iron furnaces were thrown into the Canadian market, and American pig iron found its way as far east as Montreal, at prices that, under ordinary circumstances, would be quite impossible, and that certainly did not return any profit to the American manufacturer. In many cases the bankrupt stocks held by American banks were thus unloaded, presenting a formidable competition to Canadian iron masters. Aside from this, the general depression affected the largest consumers in Canada, such as the railways, and the consumption fell short of the ordinary requirements.

Under the existing circumstances and compared with the state of the trade in the United States, Great Britain, and elsewhere, the Canadian iron industry has made very good progress in 1894, at least demonstrating that those now interested in the manufacture of iron have thrown themselves heartily into the work of development, even under most adverse circumstances.

In Nova Scotia, the New Glasgow Iron, Coal and Railway Co. have kept their furnaee in full blast from the beginning of the year, and their record of output for 1894 will quite likely equal (if it does not surpass) that of 1893. The affiliated company, the Nova Scotia Steel Co., has gone on steadily extending their operations in the steel department.

The Londonderry Co. who seek their principal market for pig iron in Ontario, have perhaps felt the American competition more keenly than the New Glasgow Co. but they have done comparatively well for the times.

The Pictou Charcoal Iron Co. at Bridgeville, were in operation for several months of the year, and although closed down at the present moment, will show a fair output.

The same applies to the work at Drummondville in the province of Quebec.

At Radnor Forges, the operations of the Canada Iron Furnace Co. in all its branches, will surpass the record of 1893. In the charcoal iron department the output is practically the same as last year.

In August last, the company after a continuous campaign of nearly two years, found it necessary to shut down for relining of the furnace, and the campaign for 1894 was from this and similar causes, reduced to a period of a little over nine months. In this nine months the company produced of high class

Charcoal Iron	7178 660/2240 net tons.
Ore made	15,866 1033/2240 "
Charcoal	663,269½ bushels.
Cordwood	23,363½ cords.

An average of some 650 men and 300 horses were employed throughout the year in the fields and at the works.

The work of prospecting has been carried on vigorously as in the past, and the ore fields extended and perfected over a very large territory.

The company has found competition very keen during the year, but the high quality of their iron has commanded a steady market for it. The auxiliary businesses in connection with the company have all shewn progress, and the value of the industry to the province, and especially to the farming community, has been more than ever demonstrated.

ONTARIO.

Aside from the difficulties experienced by Canadian iron masters in meeting the panic prices of their American rivals, another grave difficulty has recently arisen by the passage at Ottawa of an Order-in-Council, 2nd Nov. 1894, entitled, "Re-drawbacks on import goods used in Canadian manufactured articles, and exported." This Order-in-Council was passed with a view of encouraging the exportation of agricultural implements to foreign markets. The principle of encouragement was perfectly correct but the way in which the enactment is framed, and the manner in which it works, are most detrimental to the development of the Canadian iron industry, in its broadest sense.

As it stands to-day, it obliges Canadian consumers to use foreign raw material before they can avail themselves of the encouragement offered by the government, and it bars out altogether the use of Canadian raw material. A striking illustration of this was given a few weeks ago, when a Western plow manufacturer wrote to one of the iron furnace companies, and said that much as he desired to use Canadian material at competitive prices with those of American, yet, inasmuch as he exported largely to Australia and Great Britain, he was compelled to use American iron and steel, so as to take advantage of rebates from the Dominion Government.

Another Canadian manufacturer when absent from home recently, received a letter from his house reading somewhat as follows:—

"We beg to advise having just received an order for plows for shipment to Australia. The shipment must be made by outgoing steamer, and we deeply regret that we have been compelled to use Canadian steel, as we have no American steel in stock, hence we must sacrifice the ordinary rebate."

In the United States things are done somewhat differently. Manufacturers of agricultural implements are entitled to rebates equivalent to what the duty would be had they imported the raw material used in their machines, but they are left entirely free to use American raw material, and as a matter of fact they do so in almost every case.

It is quite evident that the manner in which the Dominion Order-in-Council was drawn up, and is now being acted upon, is merely an error, but it is one that should be rectified immediately, as it simply serves to nullify the protection and encouragement to the Canadian iron industry granted by the Dominion Government itself at the last Session of Parliament.

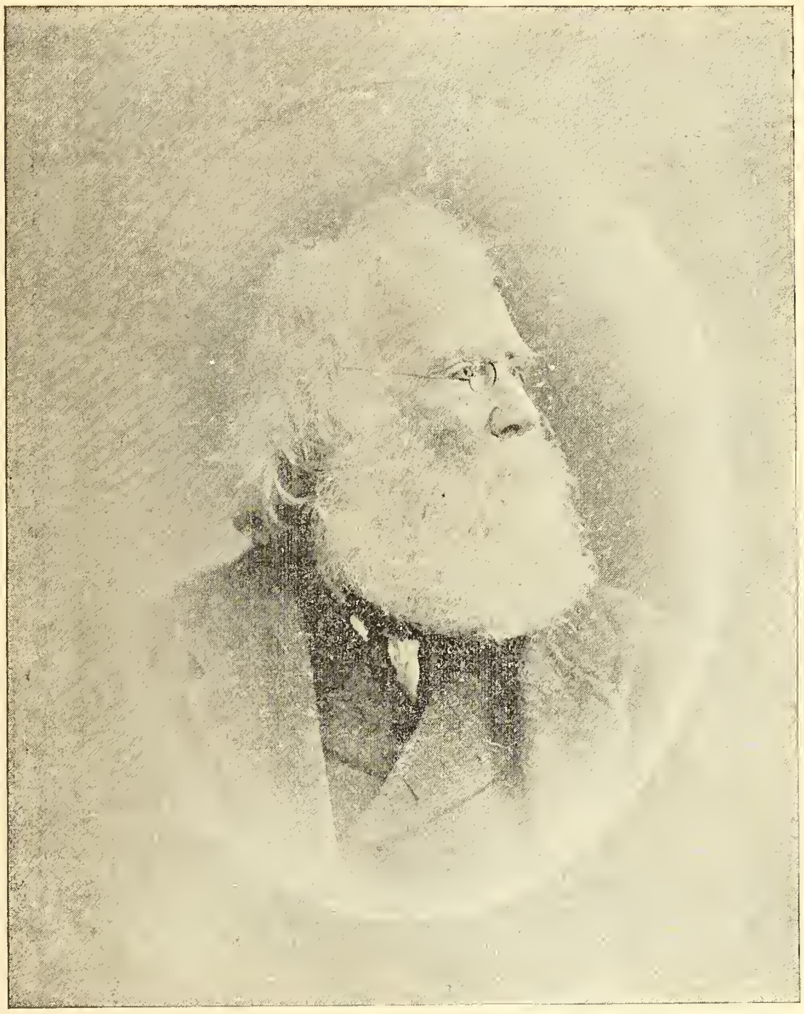
It is quite evident that so long as the Order-in-Council referred to remains as it is to-day, and the present condition of the American iron market exists, Ontario agricultural implement manufacturers will prefer to confine their purchases to American iron and steel, so that they will be relieved from the trouble and annoyance of locating specific importations of iron and steel necessary in making out papers calling for the rebate of duties.

Among other important legislative enactments of the year is one passed by the Liberal Government of Ontario, and which reflects great credit on the wisdom of the legislators of that Province. For some time back the Ontario Government have been making a very full investigation as to the importance of the pig iron industry in the proper development of the mineral wealth of the province. Their investigation has finally culminated in the passage of an Act, now in the Statute Books of Ontario, entitled, "An act relating to mines and mining lands," by which Ontario appropriates the sum of $125,000 to aid miners and producers of iron ore, in developing the ore deposits of that province.

Clause 12 of the said Act authorizes the Treasurer of the province to pay out to miners, or producers of ore, upon all ores which shall be raised or mined, and smelted in that province, for a period of five years from 1st July, 1894, the equivalent of $1.00 per ton on the pig metal products of such ore, this to a maximum amount of $25,000 per annum.

In better times the effect of this Act would likely have been ere this the formation of companies for the erection of several furnaces in Ontario. As it is, a coke furnace of large capacity is now being erected at Hamilton, Ont., and it is expected that it will be in blast during the ensuing summer. Other furnaces are talked about, and there is not the slightest doubt but that Ontario, hitherto so dilatory about developing one of the greatest natural wealths that she possesses, will very shortly, under such wise legislation as the Act referred to, come to the front in the manufacture of iron in Canada.

Geological Survey of Canada.



The late Sir Wm. E. Logan,

Director 1843 to 1869.

It will be in the best interests of Quebec if our legislators will meet the action of Ontario promptly, and not only preserve to this province the credit of having been the first iron producer, but to-day the largest producer of high class charcoal iron within the limits of the Dominion.

Quebec possesses such a great wealth of the very highest class of ores, and wood necessary for the manufacture of charcoal, that it only remains for her government and people to give the industry every sympathy, and at least give the same support as that offered by her sister province Ontario.

Copper Pyrites.

THE PRESIDENT—The mining of Copper Pyrites in the Province of Quebec for the year 1894 has been confined to the Township of Ascot, in the County of Sherbrooke. All the Pyrites mined was utilized for manufacturing acids in the first place, the copper and silver contents being subsequently extracted.

The quantity mined for the year amounted to	35,560 tons.
Of this quantity there were exported to different points in the United States	27,960 "
And consumed in Canada	7,600 "

The market for the product of these mines has been very depressed during the year, and prices very low in consequence. At the present time, with better demand and increased consumption, better prices are being realized.

The Asbestos Industry, 1894.

MR. JOHN J. PENHALE (United Asbestos Co.)—The production of asbestos for the year 1894 has been approximately 8,600 tons. These figures indicate a very marked increase over the previous year; and the shipments from the mines show that the demand for crude is very much better than it has been at any time for the last three years.

During the year just closed, the total shipments from the mines on the line of the Quebec Central Railway have run up to 7,318 tons, being only exceeded in the year 1891, when 7,774 tons were sent away.

The figures of shipments sent, do not include the shipments from the Jeffrey mine at Danville, but their output is included in the total given above.

Eight companies have been engaged in the mining of asbestos in 1894—four at Thetford Mines, viz.:—King Bros., Bell's Asbestos Co., Johnson's Asbestos Co., and the Beaver Asbestos Co. At Black Lake, the American Asbestos Co, the United Asbestos Co., the Anglo-Canadian Asbestos Co., and at Danville, P.Q., the Jeffrey Mine. Employing in all about eight hundred men and boys.

About 1,000 tons have been sent to the United States, and the balance to various European points.

The principal points of shipment in the United States are: New York, Erie, Pa., and Baldwinsville, Mass. In Europe, London, Rotterdam, Genoa, Hamburg, and Glasgow.

Very little has been manufactured in this country, there being only one firm engaged in the business, viz., M. B. Berry, of Quebec; and the record of shipments show only twelve tons sent to that place.

This, however, does not mean that only twelve tons have been used, as I am in a position to know that Mr. Berry had a considerable stock of crude on hand.

The demand for crude asbestos during the year has been fair, but the prices realised have not been up to former years—'90 and '91.

All shipments have gone direct to the manufacturers, and not as in previous years, to dealers and brokers.

Miners too have adopted the plan of mining only the quantity required to fill their contracts, so there is not now the danger of overstocking the market that there was three or four years ago at the time of the "boom."

On the whole, the past year has been a very successful one in this branch of the mining industry of the Province.

A rough estimate of the value of the production would be $516,000. This, however, may be too high.

The annual report, "Mineral Statistics and Mines," for 1892, just issued by the Geological Survey, places the production of asbestos from 1882 to 1892, inclusive, at 49,161 tons.

The record of actual shipments, via Quebec Central Railway for that period is 36,630 tons, or a slight difference of 12,531 tons in favor of the Geological Survey. I am aware that these figures are compiled from returns sent in by mine operators: but it shows at once how little reliance can be placed on reports from the Geological Survey Dept., and would give anyone unacquainted with the facts the impression that the asbestos miners were carrying a stock of 12,000 tons of crude asbestos in their sheds at that time, an impression that might do considerable injury to the market, and have a tendency to knock down prices.

Coal Imports by Rail and Water.

MR. B. T. A. BELL—The importation of bituminous coal into the Province of Quebec is of so great importance that no mineral statistics would be complete without its figures. The following returns have been compiled with the greatest care, at first hand, and are as authentic as it is possible to make them:

CARRIED BY WATER.

a) From Canadian Collieries—

General Mining Assn., Ltd., Cape Breton	109,351 tons.	
Dominion Coal Co., Ltd., "	544,953 "	
Intercolonial Coal Co., Ltd., Pictou County	80,587 "	
Cape Breton Colliery, Cape Breton	900 "	
Total water imports, 1894		735,791 tons

During the season of 1894 this trade employed 363 cargoes, 49 steamers, 18 sailing vessels and two barges, and distributed on account of labor $369,688; on wharfage, $55,586; Pilots, $55,333.

CARRIED BY RAIL.

Intercolonial Coal Co., Ltd., Pictou County	100 tons.	
Canada Coals & Rail. Co., Ltd. Cumberland County	15,800 "	
Cumberland Ry. & Coal Co., Ltd., Cumberland Cty.	98,913 "	
Acadia Coal Co., Ltd., Pictou County	5,000 "	
Total carried by rail		119,813 tons

CARRIED BY WATER.

From Foreign Collieries—

English, Scotch, Welsh and American (St. Lawrence)	73,658 tons	
American bituminous (Canals, &c.), estimated	10,000 "	
Total foreign by water		83,658 tons

CARRIED BY RAIL.

American bituminous, about	1,000 tons	
Total rail bituminous		1,000 tons
Or a total import of bituminous coal in 1894 of		940,262 tons

RECAPITULATION.

Canadian by water	735,791 tons	
" rail	119,813 "	
		855,604 tons
Foreign by water, about	83,658 "	
" rail, about	1,000 "	
		84,658 tons
Total importation of		940,262 tons

ST. LAWRENCE DELIVERIES, 1893-1894.

	1893.	1894.	Increase.
PORT OF MONTREAL.			
Canadian coal	613,279	655,779	42,500 tons.
Foreign coal	36,074	55,849	
Total—	649,353	711,628	62 275 tons.
PORT OF SOREL.			Decrease.
Canadian	16,685	11,636	5,049 "
Foreign	1,528	1,932	
Total—	18,213	13,568	4,645 "
PORT OF THREE RIVERS.			Increase.
Canadian	9,218	9,481	263 "
Foreign	nil	nil	
Total—	9,218	9,481	263 "
PORT OF QUEBEC.			
Canadian	51,587	46,559	Dec. 5,028 "
Foreign	9,520	15,877	
Total—	61,107	62,436	Inc. 1,329 "
GRAND TOTAL.			Increase.
Canadian	590,769	723,455	132,686 "
Foreign	47,122	73,658	26,536 "
Total—	637,891	797,113	159,222 "

Gold Mining.

MR. E. B. HAYCOCK—In the County of Beauce there has been very little mining doing this season, 1894.

On the Gilbert River, litigation and the want of a quiet title has much delayed mining. The American Gold Mining Co., under Mr. Fernando Wadsworth's management, ground-sluiced a large piece ready for sluicing. A few men did a little sluicing; the returns gave from $48 to $76 per day. I understand Mr. Wadsworth will push the work next season.

Although the Ditton secton has proved rich in gold, little or no mining has been done. This is a section well worth looking into; a good field for prospectors. I have no doubt the veins from which the gold is derived will be found in close proximity to the alluvial.

A little prospecting on the Du Loup and Chaudiere was done during this season, and it is being carried on with more or less success.

The Mica Industry.

MR. B. T. A. BELL.—The United States being the principal consumer of Canadian Mica, the industrial depression which has existed in that country resulted in an almost complete collapse of our mica trade during the first half of the year, the official returns for the fiscal year ended 30th June, giving only an export value of $26,553 as against $96,900 in 1893. During these periods the distribution of the product was as follows:

	1893.	1894.
To United States	$86,871.	$26,484.
" Great Britain	10,024.	58.
" Germany	5.	11.
Total	$96,900.	$26,553.

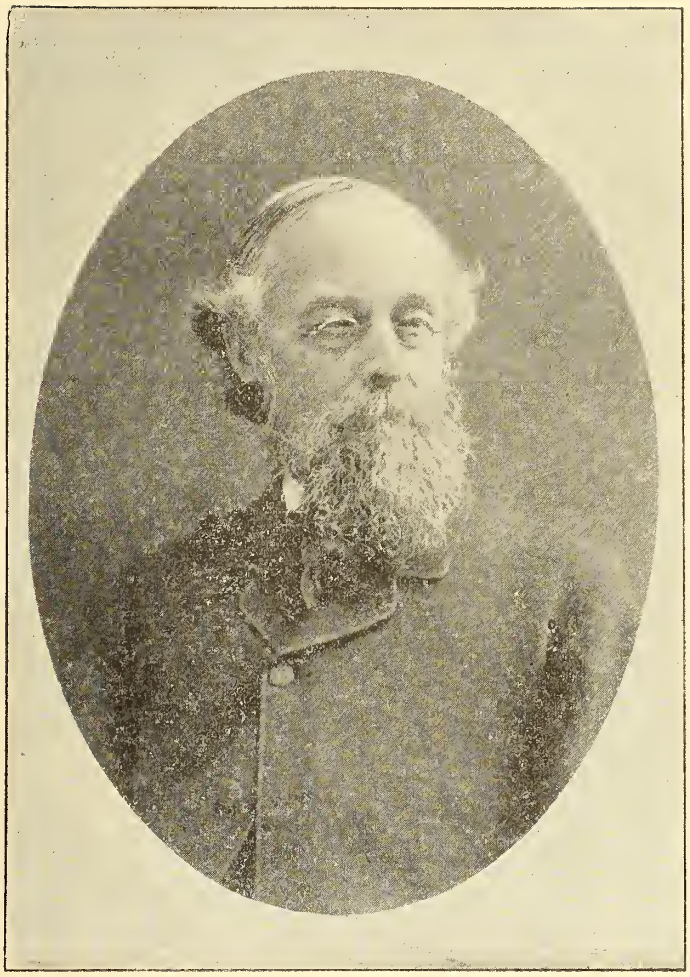
Towards the end of the season the demand increased very notably and mining was actively carried on at a number of the mines. The companies and operators were as follows:

Vavassour Mining Association	in the Township of	Hull.
Lake Girard Mica Mining System	" "	Templeton.
Wallingford Bros., & Co.	" "	Templeton.
Cascades Mica Mine	" "	Hull.
The Blackburn Mine	" "	Templeton.
Beaver Lake Mines	" "	Saugenay District.
Hayes Mica Mine	" "	Murray Bay.
McGie Mine	" "	Saugenay District.
Goldering Mine	" "	Templeton.

The total production in the Province of Quebec from returns kindly furnished by the operators being about 400 tons, employment being given to about 150 persons.

The quantity exported for the calendar year from figures kindly furnished by the customs' officials was as follows:

Geological Survey of Canada.



Dr. A. R. C. Selwyn, C.M.G., Etc.,

Director 1869 to 1895.

Port of Ottawa	$22,765.
" Montreal	4,347.
" Quebec	120.
Total exports to 31st Dec. '94	$27,232.

During the year the Canadian Mica Co., Ltd., was registered in London Eng., with an authorized capital of £90,000, to engage in mica mining in Canada. The Beaver Lake, Hayes & Perkins properties were purchased and work, we are told, is to be conducted on a large scale during the coming season.

The following is a comparative statement compiled from the trade and navigation returns showing the exports and distribution of Canadian mica from 30th June 1890 to 30th June 1894.

Exported to	1890.	1891.	1892.	1893.	1894.
United States	$26,865 00	$21,762.00	$67,238.00	$86,871.00	$26,484.00
Great Britain	42.00	550.00		10,024.00	58.00
Newfoundland	25.00		25.00		
Germany			480.00	5.00	11.00
	$26,932.00	$22,312.00	$67,743.00	$96,900.00	$26,553.00

PHOSPHATE MINING IN QUEBEC.

Mr. B. T. A. Bell.—Extreme stagnation in the European Fertilizer market together with competition from other and cheaper sources of supply have almost obliterated the mining of Canadian phosphates and the production of this mineral has been reduced from 31,758 tons in 1890 to about 9,000 tons. The exports of the year were to :—

Great Britain.	United States.	Canada.	Total.
3,239 tons.	2,000 tons.	700 tons.	5,993 tons.

Prices have fallen from 16½ d. per unit for 80% in 1890 to 7d. in 1894 equal to $8.74 Montreal F.O.B. and $6.88 Buckingham. In 1890 the lower grades brought as follows :—75% 13d ; 70% 12 d ; 60% 9 d., while in 1894 70% realized 6 d. per unit equal to $3.70 per ton Buckingham and 60% $3.00 per ton unground Buckingham. The companies who did any business during the year were the Phosphate of Lime Co., at High Rock ; the British Phosphate Co., at Glenalmond ; the Lake Girard Mica System, at Templeton ; and the Dominion Phosphate Co., at the North Star, the whole of whose shipments were to Capelton, for use in the manufacture of superphosphate.

While this industry may be considered in a state of complete collapse and old time activity may not be resumed in the immediate future, the outlook is not without hope. The expansion of the phosphate business in Europe goes on uninterruptedly, and one would be rash to predict that the end of the century will not find us nearly abreast of supply, if we do not overlap it. Mr. David Boyd, a Glasgow authority, writing in the American *Fertilizer* says :

"Besides the gregarious follow-my-leader element in the increase of the use of new fertilizers, it has been wonderfully stimulated by the abnormally low prices of rock which have now ruled for some time. The experience of the past 25 years is likely to hold good again—every cycle of low prices is succeeded by a stronger reflex current, which affects a much larger area, and does its best to make the ends of supply and demand meet but not overlap. Such confidence in the future may appear a little extravagant, in view of the enormous amount of rock now being mined on both sides of the Atlantic, but "enormous" is really a relative quantity, and the chances are that, while that word may be correct for to-day, it will have a totally different meaning when viewed from the standpoint of 1900. So long as money is abundant and cheap, so long will the enterprise representing lasting industries find favor, even if these for a time tax the patience of investors for adequate returns."

The world must have phosphate ; Canada possesses the highest quality known, scattered over a wide area ; human ingenuity will surely devise means to make these deposits available for the world's needs. Even though at present there may in some cases be disappointment in the result of phosphate enterprises, as there will be in all mining ventures, we may feel assured that a great and prosperous future awaits the Canadian industry, and that it is destined to fulfil an important part in the economic development of the country.

Canada is an immense wheat growing country, but as yet it uses only a few hundred tons of fertilizers per annum. This cannot continue and the example of other countries must be imitated. Prof. H. W. Wiley points out that 19 lbs. per acre of phosphoric acid are absorbed by grain and 12½ lbs. per acre are absorbed annually by the grass crop. The cereals and grass crop of Canada extract from the soil (*Annual Report, Minister of Agriculture, 1893*), 235 million pounds of phosphoric acid, equal to 117,972 tons of 2000 pounds. Supposing one-half only to be returned to the soil in the stable manure, there is still left a deficit of 59,000 tons of phosphoric acid. The percentage of phosphoric acid in Canadian apatite is stated to be about 33 per cent. Taking this as a fair average the requirement for the production of the needed quantity of phosphoric acid to be restored to the soil would be about 177,000 short tons of apatite. There are extensive mines and workable deposits of pyrites in Quebec and in Ontario containing 40 to 45% of sulphur suitable for the manufacture of sulphuric acid. Indeed at the Nichols Chemical Works at Capleton an important industry in the manufacture of chemicals and superphosphates has already sprung up and is expanding. The older portions of Canada which formerly raised vast quantities of grain have been allowed literally 'to go to grass,' but the knowledge of the use of mineral manures rightly applied will redeem the land from barrenness. It is therefore the duty of our Departments of Agriculture and Experimental Farms and those interested in the future of this industry to spread this information among the farming community, and by the establishment of fertilizing works continue the industry and enrich themselves and the province and the country.

CHROMIC IRON PRODUCTION.

Mr. B. T. A. Bell.—The latest addition to the mineral industries of Quebec and one of some importance in consequence of the comparative scarcity of the mineral and its utility in the arts and industries has been the development of valuable areas containing chromic iron of excellent quality at Coleraine and Thetford, on the line of the Quebec Central Ry.

The occurrence, character, uses and methods of working this mineral have been so fully described in the papers by Messrs. Obalski and Donald at the Sherbrooke meeting, that it will be only necessary to supplement their data with such information as has been obtainable respecting the output and shipment of the mineral.

A statement furnished by Dr. Reed, of Reedsdale, an owner of a number of the areas worked, shows the following production :—

Jos. Lamelin, working six months, 20 acres. Lot 10 Coleraine, 350 tons, royalty $5.00 per ton to Dr. Reed.

W. H. Lambly & Co., working six months, 28 acres in Coleraine, on lease from the Coleraine Mining Co., 700 tons.

Frechette & Co., working two months, 28 acres under lease from Coleraine Mining Co., 100 tons.

D. Wilson & Co., working on royalty lands of Dr. Reed, in the Tp of Coleraine, two months, 25 tons.

Fortier & Co. Tp of Coleraine. Royalty. Dr. Reed. 1 month, 20 tons.

Lemieux & Co. Tp of Coleraine. Royalty. Dr. Reed. 1 month, 25 tons.

Leonard & Morris, Little Lake St. Francis, six months, 500 tons.

The Anglo Canadian Asbestos Co. Tp of Coleraine, about 20 tons for two months. A total production for the year of 1740 tons, of which 801 tons were shipped, as per returns kindly furnished by the Quebec Central Railway.

Dr. Reed again called attention to differences in the buyers and sellers analyses of shipments, and urged the appointment of a government analyst whose certificate would be binding on both.

Mr. G. E. Drummond pointed out that the only remedy lay in careful sampling and the appointment at the mines of an efficient analyst.

After considerable discussion Messrs. R. T. Hopper, Dr. Reed and Mr. John J. Penhale were appointed a committee to enquire into the matter and report to a later meeting of the association.

GRAPHITE AND PETROLEUM.

Mr. B. T. A. Bell.—A large number of men have been employed by the Walker Mining Company in the Township of Buckingham during the year and several hundred tons of merchantable graphite is reported ready for the market. A 20 stamp mill equipped with suitable appliances has been erected, having a capacity of 10 tons in the 24 hours. The quality of the graphite mined by the company is excellent. From experiments made in the Laboratory of the Geological Survey, Mr. Hoffmann, F.C.S., considers that in respect to combustability it may claim perfect equality with that of Ceylon, and that it is in no wise inferior to the latter as a material for the manufacture of crucibles.

At Gaspé, The Petroleum Oil Trust, Ltd., has had a large force drilling for oil. A heavy expense has been entailed in equipping and putting down numerous wells, some of them at considerable depth, but so far as can be ascertained, only a few barrels of oil have been obtained.

The meeting adjourned at six o'clock.

The following papers were read at the sessions of the Association on Wednesday evening, Thursday morning and afternoon, and on Friday afternoon :—

On the Occurrence of Lignite and Anthracite Around Hudson Bay.

By Dr. Robert Bell, Assistant Director of the Geological Survey of Canada.

The title of my paper, as announced, is changed to read as above, so that it may give a more definite idea of the region I intend to cover in the following remarks.

The existence of good lignite, anthracite, or coal of any kind, in the northern mainland of Canada, is of so much importance that any information on the subject is eagerly welcomed. I say northern mainland, because it has been pretty well ascertained that workable coal seams to occur on some of the islands of the northern seas, all of which now belong to the Dominion. About all that is known to have been ascertained up to the present time in reference to the lignite around James Bay, was recorded either in the reports of the Geological Survey, or in those of Mr. E. B. Borron, who has made practical tests of some of the deposits for the Ontario Government ; and all the information that could be gathered in reference to the existence of anthracite on the east coast of Hudson Bay is given in my geological reports on that region. The first mention of the occurrence of this mineral on the above named coast is the following at page 325 of my official report for 1875 :

"When at Moose Factory, Captain Taylor of the Hudson's Bay Company, presented me with several specimens of a mineral having all the (ordinary) characters of a very fine anthracite, except that it contains, according to Mr. Hoffman's analysis, only a very trifling amount of ash. (Vide, Mr. Hoffman's report, analysis No. 4.) Two specimens were obtained by an Indian from Long Island, south of Great Whale River. I was told by Mr. James L. Cotter, of the Hudson's Bay Company, to whose intelligent observations I am indebted for much valuable information, that a similar mineral was reported by the Indians as occurring some miles inland from Little Whale River. I could ascertain nothing in regard to its mode of occurrence further than that the Indian who brought the specimens from Long Island stated that there was plenty of it there. It appears to have resulted from the alteration of a mineral like Albertite, by losing nearly the whole of its bitumen.

The following is Mr. Hoffman's description and the analysis above referred to. (Report Geol. Survey of Canada for 1875, page 423.)

ANTHRACITE.

"The specimen examined was very compact homogeneous ; colour, pitch black ; powder, deep black ; lustre, bright metallic ; fracture, highly conchoidal ; it does not soil the fingers. When boiled in a solution of caustic potash, it was apparently unacted on ; the solution remained colourless, and the powder black. Gradually heated or when projected into a bright red hot crucible, in either case decrepitated but very slightly. The specimen had been kept in the laboratory for months.

"The following is the mean of two very closely concordant analyses :—

Fixed Carbon	94.91
Volatile Combustille Matter	1.29
Water	3.45
Ash	0.35
	100.00

"It was scarcely changed in appearance by coking, the ash which had a reddish iron black colour was attracted by the magnet; it showed not the slightest disposition to agglutinate, even at a bright red heat."

In 1877 I visited the east coast of Hudson Bay and in my (Geological Survey) report for that year, page 24 C., is the following statement :

"*Anthracite* : The existence of this valuable mineral on Long Island was referred to in my report for 1875, page 325. It has a conchoidal fracture and bright lustre and was found by Mr. Hoffmann to contain 94.91 per cent. of fixed carbon, and only

Geological Survey of Canada.

Dr. G. M. Dawson, C.M.G., Etc.,
Appointed Director, January, 1895.

0.35 per cent. of ash. It is probable that it does occur as a seam of altered bituminous coal, like ordinary anthracite, but rather as resulting from hardened pitch, or a mineral like albertite by the loss of its bitumen, and it may not exist in large quantities. I was prevented by circumstances from visiting the locality at which it is found, which is said to be on Long Island, at four or five miles from its southwestern extremity."

It appears that a trial opening had been made by some prospectors at the above locality many years ago. Two of my men happened upon the spot when out hunting on the island one day, but they did not tell me of it till we had left the neighborhood, and it was impossible for me to return that year, and I have never been near the place since. The island is upwards of 30 miles in length. If an intelligent search for this valuable mineral were made upon Long Island, and some of the islands to the northwestward of it, important results might perhaps follow. It will be observed that the anthracite is of extra good quality. In order that expectations based upon my discovery might not be disappointed, I thought it as well in mentioning it in my report, not to allow it to be inferred that the mineral existed in large quantities until we knew more about it. Still I know of no reason why it may not occur there in some cases in deposits large enough to be valuable. If it exists in workable quantity, it will no doubt be found in the form of vein or veins, analogous to those of albertite in New Brunswick and not in beds like ordinary anthracite. In my first announcement of anthracite, above quoted, I mentioned that the late Mr. Cotter had informed me that a similar mineral was reported by the Indians as occurring inland or eastward from Little Whale River. In confirmation of this report, Mr. A. P. Low of the Geological Survey on his late traverse of the Labrador Peninsula found a vein of this mineral about seven inches in thickness. It would be a rare chance if this were identical with the occurrence mentioned by these Indians, and we may presume that these rocks hold many such veins; and this leads us to hope that sooner or later, one or more of a workable thickness may be discovered.

LIGNITE.

Indications of a variety of lignite, closely allied to bituminous coal, were observed by me in 1871, when surveying the Albany River, the most southern of the large streams, which flow into the west side of James Bay. In reporting its occurrance, I said (page 112, Geological Survey Report for 1871):

"In one place just below the mouth of the Goose River, or three miles below the point where the river turns southeast, bright red marl occurs on the north bank, and on a small island a mile further down some loose fragments of a bright bituminous coal were found. The Hudson Bay Company's officers informed me that coal had never been brought into the country; and considering that the conveyance of even light and valuable goods is so expensive in this region, this is only what might have been expected, so that I cannot suppose this coal to have been brought here by human agency.

The occurrence of lignite on the Kenogami, the great southern branch of the Albany, is mentioned in the same report. On this river, which discharges Long Lake into the Albany, there is an interesting deposit of lignite in the drift filling a preglacial channel of a stream which probably corresponded in its general course with the existing river. It occurs at six miles, by the stream, above the mouth of the large southern branch called the Bagutchewan (or Pa-wetch-a-wan). Here the river makes a sudden bend to the north and about a mile further up another similar bend. "These unusually sharp curves, which are unlike any others in the course of the stream, appear to be caused by the river traversing preglacial excavations, in the Silurian strata, which here consist of dull red, coarse, somewhat indurated arenaceous marl with green blotches and layers. These excavations have become filled up with loose material before the formation of the present river channel. At the lower bend gravel fifty feet deep is exposed in the south bank. At the upper bend the excavation of the Silurian marls is plainly seen. Starting from the level of the river, the lower ten feet of the filling of this hollow consists of boulder-clay. Upon this rests a bed, six to eight feet thick, of soft lignite, containing many flattened stems of small trees which are partially carbonized, but are somewhat elastic when newly excavated and still wet. The lignite bed is overlain by thirty or forty feet of rudely stratified red and grey drift holding rounded boulders and many pebbles. Marine shells were observed in the drift along the Kenogami, almost up to this point, which, according to my barometric readings would have an elevation of about 500 feet above the sea" (See Annual Report of the Geological Survey for 1886, p. 37-38 G.)

With reference to lignite in the basin of Moose River, I will quote the following from my report for 1877, page 4 C.:

"The existence of lignite on the Missinaibi River was referred to in my report in 1875. During the past season I have found it *in situ* in several places on this river between the Long Portage and its junction with the Mattagami. The first or highest of these was in the west bank of Coal Brook, three-quarters of a mile from its mouth. Coal Brook is a small discharge or channel which leaves the main river opposite the head of the fourth or Riverside Portage, and rejoins it at five and a half miles below Round Bay, at the foot of Hell's Gate. This bed of lignite is about three feet thick and is underlaid by soft sticky blue clay, and overlaid by about 70 feet of drift clay or till, full of small pebbles and passing into gravel towards the top. Much of the lignite retains a distinct woody nature. Some of the embedded trunks are two feet in diameter. When dry it makes a good fuel, but contains a little iron pyrites.

"On the south-east side of the river, at nineteen miles below Coal Brook, or two miles above Woodpecker Island, a horizontal seam of lignite was found in the midst of a bank of till 125 feet high. It is from one and a half to two and a half feet thick and is made up principally of sticks and rushes. Below the lignite are 80 feet of yellow-weathering grey clay and about 45 feet of blue clay. Both varieties of clay are full of pebbles, and they also hold some striated boulders of Laurentian gneiss, Huronian schists and unaltered Devonian limestone.

"At three miles below Woodpecker Island, or nine miles above the mouth of the Opazatika (Poplar) River, another bed of lignite occurs in the bank on the same side. It is six feet thick, but diminishes to the eastward and is of a shaly character, being made up of laminæ of moss and sticks. Immediately beneath the lignite is a layer, one foot thick, of irregularly mingled clay and spots of impure lignite. Next below this are 40 feet of unstratified drift, full of small pebbles, under which are a few feet of stratified yellowish sand and gravel. Resting upon the lignite are five feet of hard lead-colored clay with seams and spots of a yellow color and layers of red, grey, drab and buff. Above all and forming the top of the bank, 65 feet high, are 10 feet of hard drab clay with striated pebbles and small boulders and holding rather large valves of *Saxicava rugosa*, *Macoma calcarea* (*Tellina proxima*) and *Mya truncata*.

Small seams of lignite were seen in two places in the bank on the same side at, and again half a mile below, the foot of a rapid which occurs about six miles above the Opazatika. In the interval between one and two miles above this stream the whole bed of the river appeared to be underlaid by lignite. When sounded with a heavy pole it has an elastic feel and gives off large volumes of gas which may also be seen at any time bubbling up spontaneously here and there all along this part of the river. This phenomena has been observed by the Indians from time immemorial, and the locality has received the name of the 'Bubbling Water.'"

Since the above was written Mr. E. B. Borron, J. P., Stipendiary Magistrate for Northern Ontario, was sent by the Provincial Government to test the lignite beds of Coal Brook by boring. I have not seen his report, but I have been told that he found the mineral to be of fairly good quality, I have also been informed on good authority that beds of lignite have been found within the last few years on the lower part of the Abittibi River, where we noticed loose pieces of it in 1877.

Considering the very small amount of exploration which has yet been done in the regions referred to in the above extracts and notes, the discoveries which have been mentioned appear to indicate the existence of a good supply of lignite scattered over a vast area in the level country around the southern and western side of James Bay, where valuable deposits of iron ore are also known to occur.

"Charcoal; its Bearing on the Utilization of our Forests."

By Mr. T. J. Drummond. Montreal.

In asking the attention of a Mining Association to a paper on a forest product, I think perhaps it is best at the outset to remind you that, as so far, charcoal is the only known fuel natural to this province for the smelting of iron ore, this important product of the mine must be governed by the product of the forest. If we cannot produce cheap charcoal, and if we cannot see a supply ahead, then any attempt to establish an iron industry in this province, on anything like an extensive scale, would mean failure. The importance of this question of the production of charcoal and its encouragement, and the conservation of woods for its manufacture, therefore, cannot well be over-estimated. Canadians have truly a magnificent national asset in their forests, and every care and thought should be given to the question of how it may be utilized.

It will be unnecessary for me to dilate on the forests of the Dominion. While the variety of trees is not as great, still the area under timber in Canada is certainly equal to that of the United States, and the woods are useful and valuable. In our own province there are probably not more than fifty or sixty species, but they have already yielded a large revenue to the country, and with proper care they will continue to do so for generations to come. In fact, with a climate like ours, our supply should be unending, as it is in every way favorable to the growth of forests, and if a proper system of cutting is followed and due care given by the government through a system of inspection, new forests will spring up to replace the timber removed, where the land is not put to agricultural or other purposes. To preserve these forests, and to utilize them to the best advantage to the country, should be both a national and provincial care and if necessary, vast districts should be set aside and reserved for this purpose, over which the government should exercise full control.

We have forest wealth now, and so, as I have said, what we must consider is how we can utilize this to the best advantage to the nation. In considering this, it seems to me that as in the case of private assets, we must consider each class of wood separately, and try and find out in what way these woods can be utilized so as to return the greatest benefit in cash and labor, and in my opinion, we should not be content to be simply "hewers of wood" and allow others to reap the benefits derivable from the labor that may be employed in bringing any of our woods to a higher state of finish and value, but should encourage by legislation and otherwise, the manufacture within our own boundaries of whatever articles the variety of our woods may be suitable for.

If we are to advance in wealth and population, if we are to build a nation, we must be able to offer fair work and fair wages, and to do this, we must develop our natural resources, more especially in those directions that require the greatest amount of labor. When we have labor and the producing power of the earth working together, whether in agriculture, mining, or the utilizing of our forests, we are doing this, and the higher the point to which we can bring the earth's product, with the consequent increase of value through extra labor expended within our own boundaries, the better for our country. So, I reason, that if instead of shipping our forest products in practically a raw state, we can carry the process of finishing to a higher stage, then our forests will of a necessity yield us so much greater benefit. To a very large extent, the value of a forest tree is the value received for the labor expended in hewing it into square timber, sawing it into boards, or turning it into an article of furniture, and it stands to reason that the tree that was by Canadian labor transformed into furniture, has yielded more that its fellow that was exported in the form of square timber, or that a spruce tree shipped in the form of paper yields more than if it had left Canada in the form of sawn logs or even pulp. As with our soft or merchantable woods, so with the unmerchantable or hard woods. If we burn these woods to clear the land, it means dead loss, or if we use them for domestic fuel, the return is small, and if we turn them into charcoal and export the charcoal in that shape, the value to the country will not be very great, but if we use those woods in such a manner as to develope an industry that must otherwise be non-existent, then we have obtained something worth while, and so I hold that by burning into charcoal and using that coal for the smelting of iron, the value of the cord of wood to the country becomes the value of the labor expended in producing the amount of pig iron that quantity of wood will smelt, in other words, the value of a cord of wood for domestic purposes to the farmer would be say $1.50 to $2.00, and would yield nothing beyond that to the country. But if that cord of wood was burnt into charcoal, and by that fact an iron industry becomes possible, then as it takes from two to two and one-half cords of wood to obtain sufficient charcoal to produce a ton of iron, so it must be plain that a cord of wood utilized in this way brings through the labor consequent on raising the ore, flux, etc., and smelting, say from $6 to $9 per cord, according to the class of ore smelted and wood used. In making this statement, I am, of course, dealing principally with our Province of Quebec, where the conditions are such that without charcoal an iron industry cannot be commercially established, and where, with proper attention, consideration, protection and encouragement towards the utilization of what are known as unmerchantable and waste woods, insuring a long and regular supply of charcoal, a charcoal iron industry can be developed as great and as important to the province and the Dominion as that industry has been, and is to Sweden and the United States.

Now that I have given in a general way my ideas as to the utilization of our forests, and the bearing those forests have on the iron industry in this province, I will, in as few words as possible, explain the different systems of manufacture of charcoal generally followed, giving particularly the practice adopted at the works with which I am identified.

In cutting wood for pit burning, the custom in Sweden is to cut the logs in about 9 foot lengths, but in our own experience we have found it better to cut to shorter lengths for reasons hereafter given.

For kiln burning, the general practice in the United States is to cut to 4 ft. lengths. Formerly the cutting to lengths as well as the felling was done with the axe, but latterly the saw has been brought into general use, with a view not only to quicker work, but to prevent waste. The value of the saw in cutting the cordwood to length is considerable, for the axe chips represent a very material loss. The axe seldom makes a cut at an angle less than 45 degrees, so that in practice as much wood is cut away as remains in the two adjacent points, and the loss of chips in cutting to four foot lengths with the axe, amounts to fully from 8% to 10% according to the size of wood cut.

In the Province of Quebec, when we first took up the charcoal iron industry, we found that the practice was to work wholly with the axe, and to cut to 3 ft lengths, and we saw that this must be changed, as the loss was considerable in labor through cutting to such short lengths, and as already pointed out the loss in chips also was naturally very great. We had a great deal of prejudice to overcome. but we are now making for kiln purposes solely 4 ft. wood, and our men are using the saw for cutting to length. And we find that not only do we effect economy for reasons given, but our men are able to earn, working in pairs, with the saw, better wages than they formerly could, working singly, with the axe.

In burning into coal two systems are generally followed, viz., pit or meiler burning and kiln burning, and in the United States "retort" burning has been attempted. This is carried on, I believe, on a small scale at present, but I do not think it has ever proven to be a commercial success although perhaps if given full trial it might be found to be more eeonomical that it has so far proven to be.

KILN BURNING.

Two styles of kilns are generally used,—the "rectangular" and the "bee-hive." The latter has been found to be the most satisfactory, and has practically superceded the "rectangular" kiln. In our own experience the "rectangular" kilns have given us good results both as to durability and the making of coal, but we have found them more difficult to keep air-tight than the "bee-hive," and that they also require more experience and care in handling, being more subject to cracking and opening through being effected to a greater extent by expansion and contraction. They have also to be well bound with heavy frames of wood, which are affected by weather and time and require replacing.

Our present battery of "rectangular" kilns is, however, in first class condition, although it has been in operation about twenty-four or twenty-five years. This is perhaps mostly due to the fact that they have been carefully looked after, and repairs promptly made when necessary.

When in operation, it is necessary that the burner watch the "rectangular" kilns very closely, owing to there being a greater liability to burn down to the centre than in the "bee-hive" kilns. The form of the latter giving solidity while the action of expansion and contraction from heat and cold is not so great, and the "bee-hive" kiln is therefore easier to keep air-tight, and for these reasons the coal produced in the "bee-hive" is more uniform.

Apart from the question of coal, the "bee-hive" kiln is much easier to keep in repair, as it is not necessary to have any wood frames or binding. The wood can also be handled somewhat cheaper and faster in the "bee hive" than in the "rectangular" and owing to their greater liability to straining from expansion and contraction already referred to, the "rectangular" kilns require about two or three days longer to cool, and therefore cannot be "turned over" as often as the "bee-hive," and for general results the latter has been found to be the most suitable.

PRINCIPLE OF MANUFACTURING IN KILNS.

In our "rectangular" kilns, an opening is left from the front door to the centre of the kiln. This is made by piling the cordwood in such a manner that a canal of say 12 inches square is left in the middle of the kiln leading from the door to the centre. At this point a sort of crib work is built, known as a "chimney," leading to the top of the kiln. On all sides of this dry wood, or brands, is piled so as to fire easily. A small quantity of split brands is then placed in the hole in the centre. The wood on all sides is ranked in the same manner as cord wood and is piled as closely as possible. Along the top of the kiln the ligher wood is laid, and this for two reasons. First, it is easier to handle, and secondly, the fire will run through it quicker than through the heavy timber which is left in the centre of the kiln, then a fair quantity of light wood (or brands) is placed along the bottom and at the ends. When the kiln is closed and ready for firing, the top door is opened, and a piece of oily waste is inserted by means of a long pole to the centre of the "chimney." The draft to the top of the kiln carries the fire upward and along the top, and once fairly started, the top door is closed and the air is allowed to draw down to the lower vents, three rows of which are open around the base of the kiln. These vents are operated by the burner in such a manner as to draw the heat from point to point of the kiln, and thus to "cook" the whole mass. The direction and force of the wind have a large bearing on the manipulating of the heat, and will drive it from one side of the kiln to the other,—hence the holes have to be closed and the windward side protected to prevent combustion, as otherwise the wood would become over-heated and be reduced to ashes. The condition of the coal in the kiln when approaching the finishing point is generally determined by the color of the smoke and sometimes by the insertion of an iron rod at various points to ascertain by feeling the condition of the wood or coal. This latter mode is only occasionally resorted to.

BEE HIVE KILNS—The same mode of piling and firing applies to the "bee-hive" kilns as described in regard to the "rectangular." The fire is started at the bottom and allowed to burn upwards. Once fairly started among the light or dry wood, the kiln is closed, and as the gases escape from the wood they practically supply sufficient heat to "cook" the entire mass. Care must be taken at all times to prevent too great a supply of air to the kiln, and thus cause combustion.

The properly cooked kiln should contain only the ashes made by the wood that surrounds the "chimney" with a little from the dry or light wood on the top, the combustion of which has supplied sufficient fuel to heat the mass and cause the drying and evaporation of water and gas in the whole.

What a charcoal burner must keep before him all the time is, that the wood is to be "cooked" and not burned, so that every care must be taken to prevent combustion, and sufficient heat must be introduced into the kiln or the "chimney" or canal leading to it, or by the combustion of a small quantity of light or dry wood on top to "cook" the whole mass. The light wood, of course, will be consumed, but in the meantime it should have imparted sufficient heat to the rest to draw off the water and the lighter gasses.

The burning of charcoal is more or less a process which distils or throws out the undesirable gas leaving the mass of wood charred to the centre. If this could be carried out to perfection, the coal should be solid without any breaks or cracks or tendency to fall to pieces.

Both our "bee-hive" and "rectangular" kilns have a capacity of about 55 cords, and they generally take from ten to fourteen hours to fill, according to the class of wood handled, and from five to six days to burn, which is again largely governed by the class of wood. The "bee-hive" kilns take about eight days to cool and can be easily discharged in one day. The "rectangular" kilns generally take two or three days longer to cool, as already stated, owing to their being more affected by expansion and contraction. In our kiln work we use cord wood all the way from a limb of 2½ inches in diameter up to the trunk of the heaviest tree that is too solid or knotty to be split with the axe, so that in our practice there is practically no waste wood, as we use tops, lops and everything.

THE MANUFACTURE OF COAL IN PITS OR MEILERS.

In Sweden the coal is very largely manufactured in pits and this has been carried on on quite a large scale also in the United States. One advantage of the pit system is that farmers and others can do coal burning on their own lands and obtain the results of the labor, and at the same time the cost of transportation is naturally greatly lessened as forty bushels of charcoal can be transported for considerably less than a cord of wood, of which it is an average equivalent. In general results throughout the United States it would seem that the quantity of coal per cord obtained by pit burning has not been equal to the quantity obtained in the kilns. The general average seems to be about thirty-five bushels per cord from pit burning as against about forty bushels from the kilns. In my opinion, this is very largely due to lack of care or knowledge on the part of the pit burner, as with the same care and attention, and with a thorough knowledge of the work, there does not seem to be any good and valid reason why the results as to quantity should not be about equal. Apart from this, however, in our own experience of pit burning, the coal produced was of a better quality than that obtained in the kilns, (*i.e.*, where the work was well done.) We found the coal dense and close, and practically solid to the centre, and this class of coal develops at least 15% to 20% more gas than the ordinary coal obtained in kiln practice. It will not consume as rapidly, and gives a greater and more enduring heat, and has proved itself as economical even where an equal quantity per cord was not obtained, as compared with kiln practice.

In manufacturing coal in pits, the process of firing is practically the same as that practised in kilns, a canal being made to the centre in which to insert the fire and a "chimney" built to the top along which light wood (or brands) is placed.

The whole is then covered with eight or ten inches of evergreen branches, leaves and sand or earth. After the fire is thoroughly started, the top or the centre over the chimney will fall in, owing to the total consumption of the wood at that point, and a supply of hard wood is kept on hand, which is driven into this hole as soon as the covering shows a tendency to fall in. After it is thoroughly re-filled, a fresh covering is put on, then vents are opened along the sides towards the base. The condition of the coal inside is ascertained by feeling with an iron rod, and as the burner finds it at any point properly "cooked" he can open it and withdraw a portion of the coal, covering the balance rapidly and carefully again in the same manner as at first. This process is kept up until he knows by the color of the smoke and by the inserting of his "try rod" that the whole is properly "cooked." It is all then carefully covered in and allowed to cool and die out.

This mode of burning coal requires very careful and constant watching, owing to the liability to fire. As I have already said, the practice in Sweden is to use wood for pit purposes in nine or ten foot lengths, and when we took up the question of getting the farmers and others in our district to make coal in this manner, we had them follow the usual Swedish process in cutting, but from various reasons, principally owing to the density of our woods, the burning of shorter lengths has proved more satisfactory, and our best results have been obtained from wood cut in four or five foot lengths, and a portion of it split, and also by using smaller pits.

The pits which we first operated contained as much as forty-seven to fifty cords, but the results were unsatisfactory, the process proving too slow and too many brands being made. The coal obtained, however, was fairly good. Our burners then resorted to smaller pits containing from 20 to 25 cords of 4 ft. wood. These burned faster and gave better coal. Where our men had had experience in the work, the coal was clean and solid, and as pointed out, gave better results in the furnace than ordinary kiln coal.

In pit and kiln practice, we have used the following woods:—maple, birch, beech, soft maple, white birch, tamarac, hemlock, balsam, and in point of value they can be reckoned in the order named. Our principle consumption has been in maple, birch and beech, with which our district abounds. In practice in kilns and in pits both, we have found it possible to use 25% to 30% of soft wood, but for furnace purposes we prefer not to go above that as the coal made from the softer woods is more friable and will not carry a heavy burden of ore.

RETORTS.

In the United States attempts have been made to manufacture charcoal in retorts or closed vessels in which the wood is placed, and the charring done by external heat. In a report on this system, made by a prominent expert, he mentions that one system is to erect a furnace, and supply it with a number of vertical cylindrical vessels, which are handled with a crane. These vessels are filled with wood, tightly sealed, lifted into the furnace and connected by means of nozzles with conduits leading to condensers. After the fire has been maintained a sufficient length of time to properly char the wood the vessel is lifted out and allowed to cool, another taking its place in the furnace. In this method the retorts serve also as cooling vessels, but they must be handled, and the outlets for gases must be disconnected and closed at each change.

Another plan consists of a cylindrical retort hung from trunnions over a furnace. It is raised to a vertical position to receive the charge of wood, and reversed to discharge the charcoal into the cooling vessel, where the process is completed. The difficulty of filling these retorts and maintaining them, makes this plan undesirable.

A system largely employed in North Pennsylvania and South New York, consists of a series of cylindrical vessels set permanently in a horizontal position over furnaces. These retorts are filled with wood either thrown in, or, in improved retorts, placed in a crib which has been previously loaded. When the carbonization has proceeded sufficiently, the coal is withdrawn into a cooling tank, which is hermetically sealed, until such time when the danger of the mass taking fire is greatly reduced.

Other forms have also been followed, but as far as I can ascertain, none of them have ever proved commercially successful, and the old-fashioned kiln and pit system still seems to be for general charcoal purposes the economical, and, in fact, the only systems by which charcoal can be successfully manufactured for general commercial purposes, or at least for the manufacture of iron.

BY PRODUCTS.

Of late years considerable attention has been given to by-products obtainable in the manufacture of charcoal, and it has been found that with a chemical plant attached to a battery of kilns, that every cord of wood can be so handled that the exact weight that went into the kiln will practically be taken out, when everything is taken into consideration. What by-products can be drawn from a charcoal kiln would be too numerous to mention. In fact there seems to be very little that cannot be taken out of the wood in this way, but for commercial purposes the principal by-products, and those to which most of the companies using a chemical plant have given their attention, is the production of wood alcohol and acetate of lime, and those have been found to be, I believe, profitable, and it is very probable that within a very short time every battery of kilns will have its chemical plant adjoining, and the smoke that is now wasted will be drawn down and distilled, so that nothing will be lost. When this is done the value to the country of a cord of wood will naturally be largely increased.

Now that I have roughly outlined the systems followed in the making of charcoal, I must ask your permission to touch on the value to the country, and to this province in particular, of charcoal making, and the principal industry connected with it, and on the difficulties in the way of its development, and to ask your consideration and assistance towards overcoming those difficulties and developing the "charcoal industries."

COLONIZATION.

In colonizing our wooded lands, the value of the charcoal industry will be readily seen. Heretofore, and with good reason, the settler looked upon the wood on his lands (from which, as a general thing, the lumberman had removed the merchantable timber) as a detriment, and he (the settler) had very little to hope for until he had made a respectable clearing, and put in seed for his first crop. If he was within one or two miles of railway communication, it might be possible for him to sell a certain amount of selected wood to cord wood merchants. They did not take the run of the forest, nor would they accept branches or knotty sticks, or anything of that kind, so that at the outside he could very seldom afford to team the wood more than a mile or two, and even then, owing largely to the amount of waste, his remuneration is small. With the charcoal iron industry in the district, all this is changed, and the settler on taking up a piece of wooded land finds ready at his hand a crop that will yield good returns from the day he first swings an axe, whether he delivers his wood at kilns for burning, or at the nearest railway station in the form of cord wood, or whether he burns it himself, he can utilize practically everything, as the furnace companies can take practically all classes of wood grown in this province, and they are ready to accept the tops and branches, the large knotty sticks that cannot be split, and everything in the shape of sound wood. In our long winter months he can fell trees, saw them into cord wood and team to the nearest wood depot, or he can, with the assistance of his sons and what help can be obtained, burn the wood on his own farm in pits, and he can work at it all the year round if he desires, or during his slack season, and earn good wages whether he makes cord wood or coal.

When I speak of the importance of the fact of charcoal kilns or pits being able to utilize tops and branches and knotty pieces, etc., I think you will understand how very important this is to the settler when I say that as an actual fact, in the average forests only about one-third of the wood felled is fit for merchant cord wood, and of the balance the settler can use a portion for his own purposes, but the great bulk has to be chopped into a suitable size for piling and burning, and then watched carefully in the spring, or almost as much attention given to it by a careful settler as if he was burning for charcoal purposes, owing to the danger to the surrounding forests from fire, so that the making of merchant cord wood cannot be considered as remunerative to the settler in comparison with the making of wood for charcoal purposes. Then too, there is this burning of refuse, and I think you will understand what the danger in that is. If the settler is careless, his spring "bonfire" means the destruction of miles of valuable timber, for the settler's "clearing up" fires have certainly been instrumental in causing more forest fires than anything else we know of.

Where the charcoal iron industry exists, the wood that was formerly a detriment becomes a valuable asset to the settler, and he realizes it, and knowing it to be an assurance of abundant and remunerative labor, he becomes a caretaker of our forests instead of a danger, for with good cause the owners of timber limits have grown to look upon the settler as something to be kept out if possible, through fear of the effects of his spring burnings.

Where wood can only be sold in the form of merchant cord wood, as I have already pointed out, it would scarcely pay the settler to locate further back than say two miles from the railway line, if he was looking forward to obtain anything for the wood he cut, but where charcoal iron industries exist the better average price obtained allows of his teaming his wood greater distances, and if he burns into charcoal he can afford to transport that material even farther.

VALUE TO THE FARMER.

The value of the charcoal industry to the farmers of the district is, of course, the same, to a large extent, as that derived by the settler. During slack seasons they can make wood and coal on their own lands at remunerative figures, or they can arrange to work on adjacent lands, and use their horses during the winter months for teaming their own wood or coal, or that of neighbors, and where they are not desirous of working on their own lands they and their sons can find work in contractors' camps either felling, or teaming, or burning.

The charcoal iron industry is essentially a farmer's industry, and affords, both from coal and ore, steady and remunerative labor from one end of the year to the other if necessary, and certainly in all slack seasons. Our farmers have, unfortunately, a good many slack seasons, and I think it is largely due to this fact that farming has not been as remunerative as it might be. There are so many months in the year when there is nothing for the farmer to do and he has to live during those on the results of the other months. Now if he is an industrious man, and there is a charcoal iron industy in the district, he can fill in every day of his off seasons. As I have said, in winter he can fell wood, burn charcoal, and team either on his own or neighboring lands, and in early spring time, if he has confined himself to cutting wood during the winter, he can burn his coal then, and in the summer time from seed time to harvest he can find employment in the ore fields raising ore and teaming, and in our St. Maurice district he can, in most cases, make and wash ore on his own land, and the result in that district is that both settlers and farmers are prosperous, and reports which we have received direct from the farmers themselves and from the Curés of the district go to show that since the establishment of our works in the St. Maurice district the agriculturists have reaped large and lasting benefits. They have obtained plenty of remunerative labor during off seasons, and a good market for whatever produce they have raised on the farms.

The province of Quebec, as I think was very fully pointed out in a paper last year, has every natural requirement for the production of charcoal pig iron, and the value of such an industry to the Province and the Dominion must be fully recognized by every one. We have the iron ore, and while we have neither coal nor natural gas, we have plenty of hard and unmerchantable or waste woods, and this fact makes it possible for the establishment of an iron industry of the greatest value, and I see no reason why such an industry should not be carried to a successful issue, as it has been in Sweden and the United States. What is wanted, however, is the assurance of an adequate supply of charcoal, both for the present and the future. To do this some steps must be taken by our government to conserve certain woods or portions of forests so that this industry can be established on a permanent basis. How this can be done is some thing that will have to be carefully thought out, but if it is done the valne to Canada will be great. If it is not, then we will have wasted a very large proportion of our forest wealth, for that is wasted which is not used to the best advantage, and I hold that more profit can be derived from our unmerchantable and waste woods by utilizing them and conserving them to the development of the charcoal iron industry than in any other way. If this is done the establishment of the industry is possible and certain, if it is not, then it can only be carried on in a very desultory way.

One of the principal difficulties that stand in the way of the establishment of the charcoal industry in some of the districts is the fact of large tracts of lands being held by limit holders. Limit rights were originally intended to convey an area valued for its merchantable timber alone, yet the limit holders, even in cases where the merchantable timber has been removed, still retain possession and control, with the result that the hard and unmerchantable wood cannot be utilized. The only way by which these woods can be diverted is by actual settlement, and, as in a great many cases, the land may not be suitable for agricultural purposes, the wood, if these conditions are to exist, is practically inaccessable.

Another great difficulty is the lack of knowledge in regard to charcoal burning. Of course so far as kiln practice is concerned men can be readily obtained or educated to good practice, but for pit burning it is necessary that a much broader system of education than could be carried on by a private enterprise should be adopted, as a knowledge of pit burning would be of the greatest value to our settlers and farmers in the wooded districts.

Now, these two questions are, I hold, provincial and national ones, and these difficulties should be considered and overcome by our governments.

In Sweden there are national schools for charcoal burning, which have done and are doing good work in training men and spreading information throughout the country as to the most economical systems of making charcoal, especially in pits. Both the Dominion and the Provincial Governments should follow this example, and disseminate useful information on the subject among agriculturalists, especially in the wooded districts and where charcoal consuming industries have been or can be established. This should be done by lecturers, papers, and in every practicable manner. The practice, especially of pit burning should be taught in our agricultural institutions, and certainly no mining school should be without a course in charcoal burning, and when development comes, as it surely should come in a land of wood and iron, national schools should be established, as in Sweden. Our governments have spent large sums in this way on dairy practice, and we all know that the results have been profitable and satisfactory, and I believe that if the same course is adopted in regard to charcoal making, which is a farmer's and practically a domestic industry, the results will be also to the national good.

Steps should also be taken to prevent the locking up by speculators or others of woods suitable for charcoal purposes, and where this evil exists, as in the cases I have referred to, it should be overcome by just changes in the present laws if necessary. I do not believe that in the case of the limits any value was considered or paid for, nor was it intended to convey to the limit holders the unmerchantable woods for which lumbermen and others purchasing these limits have no use. This is proven by the fact, I consider, that at all times the government has reserved the right to settlers taking up any portion of the land, the only reservation in favor of the limit holder being in regard to the merchantable wood, which he is given a certain time to remove. I therefore hold that under all circumstances, and especially where the lands are not suitable for agricultural purposes, and the unmerchantable wood cannot be realized on through the settler, the government should have the right to divert unmerchantable wood to other purposes when and where it is deemed advisable.

When an enterprise that requires this fuel can be started in any district, it should be especially encouraged by the setting aside of woodlands to insure a continued supply and by assistance in teaching the principles of "burning" to the inhabitants of the districts, and by rebating of stumpage dues where the wood is used for charcoal purposes, and encouragement given in every practicable manner within the powers of the Dominion or Provincial Government.

The industry is, and must always be, if successful, a settler's, a farmer's, and a people's home industry, and for this reason it is especially deserving of national support and encouragement.

Our farmers should be taught and enabled to use to their own and the nation's profit everything the land has to give, and here are mighty crops wasting, burning and rotting that properly used might here in Canada, and especially in our own Province of Quebec, be made, as in Sweden, the mainstay of a nation.

Mr. President and gentlemen,—This is a "burning" question. Let us hope it will not remain a "burning shame," but in the near future become a "burning" success.

Mining as an Investment.

By Robert C. Adams, Montreal.

If one wishes to give a capitalist cold shivers, he can usually produce the effect by requesting him to invest in a mine; or if he desires to descend to the depths of humiliation he can get there speedily by taking to heart the scorn and contempt which, by word or look, often meet the solicitation to risk money in digging. Yet we learn from the last U. S. Census that over one thousand million dollars is invested in the country in securing the earth's products from beneath its surface. The exact figures are $1,284,911,405. Such an outlay would not be made unless it afforded a considerable amount of profit to some of the workers. It is therefore safe to assume that the mineral producing industries are often profitable, though whether they are so on the average is a matter for question. Especially does this doubt pertain to the mining of precious metals, which, in many instances, gives *bonanza*, but in more cases yields *borasca*. A statement of some of the facts and figures relating to the gold, silver and copper mines of the United States will enable us to form some conclusions as to the pecuniary results of mining operations.

The *Engineering and Mining Journal* publishes a list of 144 dividend paying mines and 149 non-dividend paying mines. The latter have never paid a dividend and some of the former have not paid a dividend since 1870.

Of the dividend paying mines 51 have paid over a million dollars and 25 of these have paid more than their capital stock. Of the 51 only 27 have paid dividends since 1891. Only 13 of these have paid more than their nominal capital, and only three companies that have paid a total of less than a million, and have paid dividends in the last three years, have paid more than their capital.

The 144 dividend paying mines are capitalized at a total of $643,000,000. If 25 cents on the dollar has been paid in, this would give of cash paid $161,000,000. Assessments have been levied to the amount of $53,000,000, making total cash paid in $214,000,000; the total of the dividends paid is $241,000,000, so that the returns would be about 13% more than the principal. But if only 10% of the share capital was paid in the profit would be over 100% on the investment beyond the repayment of capital.

Taking the whole list of 293 mines the total capital is $1,164,000,000, and the total assessments $85,000,000 = $1,249,195,066. Total dividends are only 20% of this amount. If 25% of the capital has been paid the total dividends would be 60% of the outlay. If only 10% was paid, 118% of the outlay would have been returned. Some eminent authorities, whom I have consulted, tell me that probably not more than 10 cents on the dollar of the capital has been paid in on the average.

When we consider the large number of mines that are abandoned before they are turned over to companies, and of the prospects that never become mines, but are spoiled in development, besides the great expenditure made in the unsuccessful search for minerals, we are forced to accept the common statements that more money is put into the ground than ever comes out of it, and that every dollar costs a dollar. Indeed many assert that dollars, whether silver or gold, cost at least two dollars apiece, and Mr. Del Mar has stated that every dollar secured from the Comstock Lode has cost five dollars. It was often said there, as in other less favored districts, "It takes the product of one mine to work another."

CAPITALIZATION OF MINES.

Of these 293 listed mines in the United States, 223 have a nominal capital of a million dollars and over, and of these 70 are capitalized at $10,000,000 and over. But the capital stock gives no idea of the amount of money actually paid in. It is customary in California to capitalize the companies at ten million dollars and sell the shares at one cent or ten cents on the dollar or even give them away, anything in fact to get them into the hands of people who will pay assessments.

The U. S. census of 1880 reports 140 mines whose nominal capital is $1,019,111,250, but whose market value is $85,641,222, or about 12 cents on the dollar, but even these prices were probably inflated above the true values.

The last U. S. Census gives some important data:

In 1889 the value of production of gold and silver was...	$99,283,732
The operating expenses were estimated at..............	63,451,136
Leaving a surplus of..................................	$35,832,596

The capital invested was $486,323,338 so that the profit was about 7½% on the investment. But when the short lives of mines is considered and the consequent deterioration of capital is taken into account, this showing must be regarded as proving that mining for the precious metals does not pay on the average.

Of 6,004 mines that are known 1,266 were idle; 1,009 were working, but non-productive; 1,610 were producing less than $1,000 per annum; 1,408 were producing less than $10,000 per annum; 437 were producing less than $50,000 per annum; 95 were producing less than $100,000 per annum; 107 were producing less than $250,000 per annum; 44 were producing less than $500,000 per annum; 28 were producing over $500,000.

SUCCESSFUL MINES.

Leading the list of the United States comes the Calumet and Hecla Coppe Mine, which, with a share capital of $2,500,000 and paid assessments of $1,200,000, has paid in dividends $40,850,000. Then come in order the Ontario Silver Mine, Utah, with total dividends of $13,175,000; Granite Mountain, silver, Montana, $12,120,000; Quinsey, copper, Michigan, $7,070,000; Idaho, gold, California, $5,489,000; Homestake, gold, Dakota, $5,237,500; Eureka Consolidated, silver and gold, Nevada, $5,112,500; Richmond, silver, Nevada, $4,359,887; Horn Silver, Utah, $4,930,000; the Tamarack, Standard and Small Hopes Consolidated have paid over $3,000,000, and the Daly, Minnesota Iron and Plumas Eureka over $2,000,000.

California from 1848 to 1881 produced $1,163,000,000 in gold and $15,000,000 in silver.

The yield of the Comstock Lode in Nevada from 1860 to 1890 was $350,000,000 and $130,000,000 were paid in dividends. The bulk of this was produced during the first 15 years. The original purchasers of the Comstock paid $50 for three-fourths interest and bought the other quarter for an old blind horse. One of the mines, the Virginia Consolidated, paid $42,930,000 in eight years, and the California paid $31,320,000 in five years. The original discoverers, as usual, got no benefit. This summer a car load of ore from the Mollie Gibson Mine at Aspen, Colorado, yielded 20,000 ounces of silver to the the ton, or 85%. More than four-fifths solid silver.

Did time permit, similar stories could be told of mines in Australia and South Africa. An expert sent out by the Rothschilds to Witwatersrand reports that one billion dollars in gold is available in that district, and one of the newly discovered mines in Coolgardie, Australia, is reported sold for £250,000.

Australia in 1852 produced $79,200,000 in gold, and in 1853, $50,400,000. Two gold nuggets were found worth $42,000 and $48,000. In California single nuggets have been found worth up to $30,000. One claim on Carson Hill had a vein from which gold was chiselled out in big chunks, one weighing 112 pounds, a single blast gave $110,000, and the yield in two years was $2,000,000. Many miners working single handed washed out from $100 to $1,000 a day. Three sailors on Murderer's Creek got 11 pounds daily and $2,700 has been washed from one pan. The Doran Mine in South Carolina yielded $300,000 from a space 300 feet long by 12 feet and 15 feet, the excavation of which should not have cost $20,000.

Canada is not without its stories of bonanzas. The early history of the Cariboo and Fraser River Districts in British Columbia abounds in stories of sudden fortunes; and the great hydraulic operations now in progress produce results that promise yields in single workings of $1,000 a day. The greatest yearly gold production of British Columbia was $3,913,563 in 1863, but this had declined to $399,525 in 1892. The highest average earnings per man in one year were $1,223 in 1875. The earnings for 1892 were $298 per man employed, or about $1 per day.

In Nova Scotia there have been some brilliant successes in gold mining, and a steadily productive and fairly remunerative industry is being carried on. The yield of gold for 1892 was 21,080 ounces, and the yield for nine months in 1893 was 14,030 ounces representing 97,471 days' labor, or an average of nearly $3 per day per man employed. The total yield of gold was about $10 per ton of rock crushed.

In the Chaudiere District of the Province of Quebec there has been some remarkable finds of gold in the streams, and if titles could be made clear and proper methods employed some large fortunes might be realized

The story of Silver Islet gives the greatest romance of Canadian mining. The original owners became discouraged and sold it for a moderate sum to United States capitalists. These prosecuted the development on a large scale and were rewarded by striking extensive deposits of ore that were often almost solid silver and for a time yielded an immense revenue.

In Hastings County, Ontario, there are gold-bearing rocks that are destined to realize fortunes to investors when the chemical secret is discovered as to a means of overcoming the effect of arsenic in the amalgamation of ores.

The nickel mines of Sudbury produced in 1892 2,413,717 pounds of nickel and 2,203,795 pounds of copper, and one of the companies is paying a dividend of 8% per annum on a capital of $2,500,000.

SPECULATION.

As good an illustration as can be had of the chances of investment in mining shares is furnished by the history of the dealings on the San Fransisco Stock Exchange. "Crown Point" in November, 1870, sold at $3.00 per share. On favorable reports it advanced to $1,800. Other mining shares rose in proportion and all California went wild. In 1872 the crash came and silver stocks declined $60,000,000 in ten days. A friend of mine who could have sold out his holdings for $800,000 but who was determined to become a millionaire ended $60,000 in debt, with a lawsuit on his hands.

In 1872 Virginia Consolidated began paying dividends of $300,000 monthly. An expert said there was $1,500,000,000 in sight in the two mines, Virginia Consolidated and California. Shares rose from $4 to $780 and were maintained with some fluctuations for a considerable time. In 1875 Virginia Consolidated produced $15,000,000 in seven months. Then came a decrease in production and Comstock values sank $100,000,000. The Bank of California failed, and Rolston's body was found in the sea. In January, 1875, the market value of Comstock shares was $300,000,000. In the spring of 1885 it was $2,000,000; in the autumn it rose to $70,000,000, and in 1890 it was $6,000,000. Stock that sold for $700 in 1875 sold for 25 cents in 1885. During the excited dealing in shares in 1872 one man made 25 millions, another 20 millions, and two others 10 millions each.

Placer and hydraulic mining is now receiving much attention. After the first outlay is made the average cost of washing one ton of gravel by hydraulic process is three to ten cents, whereas the cost of mining and milling the most favorable free milling gold is one to two dollars per ton and is often nearer five dollars; and the mining and treatment of silver ores sometimes runs up to $100 a ton, and is seldom under $20. The first outlay for hydraulic mining is usually heavy and the cost of 154 ditches in California was an average of $70,000 each, or $3,800 per mile.

As to the profits of mining in the present day it should be said that there are numbers of small companies in California and other States that are paying from $1,000 to $40,000 a month. They are usually each controlled by a few people, who are looking for results from legitimate mining rather than from stock speculation, so there are no puffs in the papers and one rarely hears of them. Probably the number of mining properties that are being worked by individuals or close corporations far exceeds those that are listed upon the stock exchanges.

No estimate can be made of the amount of money expended in prospecting and developing mineral properties, yet the money expended in these preliminary operations should be considered when reckoning up the profits of mining as a whole. There has been a thousand prospectors at one time ranging the mountains of the Kootenay District (B.C.), and it is safe to say that more than a million dollars has been spent in the last three years in exploring and developing the Slocan District alone, whereas the ore is only now beginning to go to market in appreciable quantities and no mine has yet repaid its outlay.

During the palmy days of California $60,000,000 were produced in one year. But 100,000 miners were employed and the average output was only $2 per day per man, while wages were $4 and $5 per day. This shows that although many made fortunes, more made little or nothing. Mining is a lottery with few immense prizes, numerous moderate gifts and a multitude of blanks. The losses in mining are often due to other causes than bad luck. Managers on the Comstock built mills and reduced ores at a cost of $15 per ton, but charged the other shareholders $14, which was often as much as the ore produced. Law suits and disputes about titles have heen a fruitful source of the loss of time and money. One law suit between the Ophir and Moscow mines on the Comstock Lode cost $1,070,000.

A great hindrance to profitable mining in Western Canada is the fact that while supplies can best be obtained from the United States and that the market for ores is mainly in that country, the policy of the Canadian Government has been to maintain the tariff on these supplies and to prevent the development of railway communication with the South.

The high rate of wages in the West, $3.50 per day, and the excessive cost of transportation are causes for many mining failures.

There are two classes of investors in mines. The first class is composed of those who invest, hoping for profit from the sale of the property or its products. The second class consists of speculators who buy mining shares for a rise. The investors in public companies in England are usually of this second class, and most of the companies that are promoted are organized for the purpose of gambling in the shares. The promoters employ brokers to buy and sell shares on the stock exchange until the outside public are attracted. When the prizes have been forced to a suitable point, or to where it is thought they will not go higher, the original holders unload their shares.

To those who wish to speculate in mining shares, this advice may be given. Select some company that has great names in the directorate and is under the management of some well known, successful financial firm. Do not concern yourself too much about the merits of the mine, for if you are an outsider you have no chance of learning the truth about the value of the property. Content yourself with following the lead of men who are good "boomers" and who have a strong interest in "whooping up" the enterprise. Consider that the probability is that the affair is a swindle and will eventually be a dead loss to the shareholders. Therefore when the shares advance sufficiently to afford a good profit, do not hold on too long, but sell out before the downward turn comes.

To those who wish to invest in the legitimate mining industry for the sake of dividends from the operations, the following general rules may be given: Avoid the companies with showy names, heavy expenses of management, large capitalization or where large amounts are paid for the property. Favor investment with men of whose trustworthiness you have personal knowledge, or whose skill in mining has been proved. When you can "get in on the ground floor" with such men "take a flyer," if you have any spare cash to lock up and will not be distressed if it is lost. If you know some good practical prospecting miner, who is ready to explore in some district of good repute, "grub stake" him, that is put up the money for his expenses and go halves with him in his discoveries. You cannot expect to be able to form any accurate judgement of the value of a mining property unless you have a thorough familiarity with the business. If you visit the mine you will only see a hole in the ground and will know no more of its productive capacity than you did before. Your investment must be made usually upon the basis of personal confidence in the managers of the enterprise or the reports of your professional advisers.

From the consideration of the facts and figures which have been mentioned, it may be assumed that mining on the average is not a very profitable undertaking, that is, more money is put into the ground than ever comes out of it. But many enterprises pay fairly well, and some of them pay enormously. It is the chance of large profit and sudden acquisition of great wealth that tempts men to invest. When a great strike is made, hundreds and thousands invest in the same neighborhood hoping for similar luck. These fortunate discoveries have been called "the devil's decoy ducks" as they draw many to the spot and often to the slaughter. It must be admitted that mining success is often a matter of luck. Some of the largest properties have been discovered by accident or have become valuable by almost the last stroke of work before their proposed abandonment. Many of the discoveries have been made by unprofessional men, and the theories of skilled engineers have often been worthless. Miners say "The mineral is where you find it and one man can see into the ground as far as another."

When we remember that it is said that only four or five men in a hundred succeed in commercial business, we must not be too exacting as to the record of success in mining. The men who gamble in stocks or corner produce probably loose as largely in proportion as those who invest in mines and they lack the moral satisfaction of having promoted production or employed labor. Public spirited men have every patriotic and philanthropic motive to invest in mining.

England owes her supremacy to her coal and iron mines. It was due mainly to the desire to obtain the precious metals that America was discovered, and the development of the Pacific slope and the construction of the transcontinental railways is largely due to the mining industries. Australia and South Africa have been opened up largely by miners. The miner has also often discovered possibilities for the production of agricultural wealth. A mine gives work directly and indirectly to a large number of people. The man who has lost money in the actual working of mines can comfort himself with the assurance that his effort has tended to the development of his country and has benefitted hardy laborers. It has not, as is often said, been merely thrown into the ground.

The investment in railways is probably no more remunerative than the investment in developed mines and offers fewer opportunities of brilliant success. Mining will always attract adventurous enterprise and as the tendency of the times is to conduct its operations upon a business basis, its hazards will be continually reduced.

It may be proper to ask, why it is that so large a proportion of mining enterprises are successful? The answer will be that in addition to natural risks there is added a large element of human risk; faith in nature cannot always be supplimented by faith in man. Ignorance, bad management, dishonesty, extravagance often spoil favorable chances. The blind competition and vexatious opposition among rival enterprises sometimes ruins undertakings that by a spirit of co-operation and a reasonable combination might have been carried to success.

Instead of the present wasteful system of individual operations, there should be larger enterprises by which a whole district should be operated co operatively under one central management, composed of the ablest engineers and political business men, or in some cases it might be undertaken by the local or general government.

Dr. Raymond in his report on The Mines of the West in 1869, in a criticism of the methods employed at the Comstock, so powerfully describes the cause of many mining failures, that his words are worth reproducing. He says, "One great cause of trouble is the fact that mining has not on the whole been profitable to individual adventurers. And of this fact the Comstock Lode has furnished a striking example. Nearly $100,000,000 have been extracted from that one lode within the past nine years, yet the aggregate cost to owners has been almost as much. The reason is simple. Unnecessary labor has been employed and vast sums of money wasted in extravagant speculations and ligitations, and the root of the whole evil lies in the system of scattered, jealous, individual activity, which has destroyed, by dividing, the resources of the most magnificent ore deposit in the world. Thirty-five or forty companies each owning 10 to 1,400 feet along the vein, and each almost without exception, working its own ground independently; 40 superintendents, 40 presidents, 40 secretaries, 40 board of directors, all to be supplied with salaries, or worse yet with perquisities, or, worst of all, with opportunities to speculate; an army of lawyers and witnesses, peripatetic experts, competing assayers, thousands of miners uniting to keep up the rate of wages; these things explain the heavy expense of Comstock mining. Aside from this immense drain of money amounting to 20% of the whole production, the labor actually performed has been, for want of united action, often useless. There have been tunnels enough run by different companies into the Comstock Lode, to make, if put together, the whole length of the Sutro tunnel. Hardly one of them is good for anything to-day. The Bullion Company, which has the deepest shaft on the lode, never had any ore, but has spent more than a million dollars in prospecting, while some neighboring mines, like the Little Kentuck, have been in bonanza for long periods. Now this division of a vein which gives the rich chimney to one owner and the barren intervals to another, is not conducive to economy. The result has been that both owners waste money. All the explorations in the barren mines of the Comstock could have been executed with the money flung away by the mines that have had, for a time, rich ore."

Alluding to these operations Dr. Raymond speaks of "the mischevious feeling that mining is half grab and half gamble; that the only way to make money at it is to dig out what rich ore you can get, and then find a fool to buy the property, or, failing that to make a fool of that collective individual the public and to 'unload' yoursel of your stock."

It is so generally the custom with those who write of mining to indulge in enthusiastic language and brilliant statements that I may be blamed for presenting to a Mining Convention a paper in which the boom element is so conspicuously wanting. But it may help the reputation of the mining community if we tell the truth occasionally, especially when it can do no harm, and it may help to overcome the popular prejudice as to the veracity of promoters, which is expressed in the adage, "he lies like the prospectus of a limited company."

While admitting the losses in mining, I have tried to call attention to its frequent gains, its occasional sudden fortunes and the fascination as well as usefulness of its ventures. I have wished to point out also that a good deal of the loss might be avoided by more careful and intelligent management and especially by the adoption of the systems of combination and co-operation that are so generally being employed in other industries and which are destined to ultimately replace the individual isolated method of work.

It might be worthy of consideration also whether a mining association might not undertake some practical operations as an object lesson to the world of how mining can be successfully conducted. If all the brilliant ideas and genius that scintilate in a convention's papers could only be applied to productive work the reputation of mining might be so enhanced that it would be more sought as an investment.

Asbestos Club.—The regular meeting of the members of this Club was held in the Club Room, Black Lake, Que., on Thursday evening, 31st January, when papers were read by Messrs. E. Wertheim, Chicago; H. J. Williams, Thetford Mines, and Dr. Wm. Glen, of the Baltimore Chrome Works, Baltimore. Dr. Glenn's paper we hope to reproduce in the next issue of the Review.

Mineral Waters.

By Mr. Jas. T. McCall. Montreal.

It may appear at first sight as if my subject was hardly within the range of those usually dealt with by the Quebec Mining Association, and I venture to think that very few miners in taking out licenses for mining, prospecting, or in purchasing mining rights on any property, would include a spring of mineral water among the valuable deposits they expected to find. A little reflection, however, will show us that natural mineral waters have been a source of great wealth and prosperity to those countries, and more particularly to those districts, in which they have been found. Springing up from the depths of the earth, charged in the most natural manner, and in the most delicate proportions with those chemical substances that give tone and vigor to the human system, these mineral springs must be regarded as of great value, to be plaeed on a level with gold and silver, iron, copper and lead, asbestos and mica deposits, which have been considered as forming the great mineral wealth of this province.

We all realize, I think, of what immense importance a supply of pure water is to any town or city. Blessed as we are, with a plentiful supply of fairly excellent quality in Montreal, we are not brought face to face with the difficulties which some other cities in Canada, Toronto for example, have had to contend with.

In reading over several papers in connection with my subject, it was noteworthy to find what a strong stand a great many eminent physicians take on this subject. They point out that to impure water supply can be traced the great epidemics of cholera, typhoid fever, diphtheria, as well as those lesser diseases which distress suffering humanity. Most of us will remember the experience of the City of Hamburg during the cholera epidemic on the continent two years ago. It was the contaminated water of the Elbe, the source of the drinking supply of that city, that was responsible for the devastation made among its inhabitants. The same can be said of the great majority of towns on the Continent of Europe. The dangers surrounding a journey through a foreign country, such as Italy, Germany or France, or other Continental States, are manifold, on account of the impure water supply, and to all who purpose making such a trip, let me advise them never to drink ordinary water. If their principles will allow of it let them drink beer or wine, but if they must drink water, let it be bottled mineral water.

A recent writer referring to the saying, "See Naples and die" claims that this originated through the dreadful water of that city finding so many victims.

The drinking of mineral waters for medicinal purposes dates very far back, and the famous wells of England used to be the fashionable resort of the wealthier classes during the eighteenth century. After a season of gaity and high living in London, the fashionable ladies and gentlemen went down to Bath or Buxton, or some other similar well, to have a course of the waters to wash away the ill humours and bad blood that had resulted from their previous style of living. This is now changed to a large extent, and the fashionable world go to the Continent, where such baths as Hamburg, Baden Baden, Carlsbad, etc., are thronged with people in pursuit of health.

It will thus be seen what a source of wealth these springs and baths are to the districts in which they are found.

Our association is at present purely a Quebec institution, and I will not, therefore, refer to points outside of it; my object now is to point out that we have in this province a vast wealth of mineral waters, as fine, if not finer, than any to be found on the Continent of Europe or in the United States.

My chemical knowledge is not sufficient to enable me to give you a scientific division of the various kinds of mineral waters found in this Province, but for my present purpose it is sufficient to divide them broadly into two kinds, medicinal and table waters. The division is not a very accurate one, for table waters are and must be of very great medicinal value, but the distinction is easily understood, and cannot be mistaken.

Let me first of all draw your attention to the medicinal waters, by which I mean those whose chemical ingredients are of so strong a taste or odor, or present in such quantities as to make their functions more especially medicinal than otherwise. Nearly every district has mineral springs of some kind, be they sulphurous, alkaline, or saline in their composition, but very few have ever attained more than a local celebrity.

Among these I would mention the following most important, Richelieu Water—a well owned by Mr. J. A. Harte, of Montreal. This is an alkaline water of great medicinal value in cases of acidity of the stomach. Its taste is not such as to make it unpalatable, although it is pretty high in salts.

Varennes—This is a strong saline water, of the same nature as St. Leon.

Abenakis—This is a strong saline water.

St. Genevieve—This spring is also owned by Mr. Harte, and may be considered a fairly strong purgative.

The Caledonia Springs are in the Province of Ontario, although pretty close to the Province of Quebec, so they are not within the scope of my paper, although in passing I would mention that there are three wells there, saline, sulphur and gas. This water has obtained considerable celebrity on account of its medicinal qualities, and the hotel at the Caledonia Springs is regularly frequented during the summer months.

I have brought up some specimens of these waters found in the Province of Quebec, and will be very glad to submit them to you for the purpose of testing.

The most famous of these, at least the one that has been brought most prominently before the notice of the public, is the spring at St. Leon. This is situated near Louiseville, on the Quebec section of the C.P. Ry. The principal ingredients are:

Chlor. Sodium, Chlor. Potassium, Chlor. Magnesium; Bi-carb. of Lime, Bi-carb. of Magnesium, with Lethium and the Iodides and Bromides of Sodium.

These are present in such quantities as to warrant us in classing this as a fairly powerful water. (These are of course modified by other chemicals, such as bi-carbonate of iron.)

Prof. Baker Edwards, in writing in connection with the analysis, says:—

"This rare water combines marine chlorides, bromides and iodides, also rare alkalines, lithium, barium, strontium, very powerful alterative metals, their actions modified by the chalybeate, carbonates of iron and magnesium, all super-saturated with carburetted hydrogen gas so as to protect them from alteration by oxidation or air. Nothing rarer could be conceived."

The medicinal value of this water has been long recognized, and it has been reported on very favorably by a great number of well known physicians, especially for the relief of disorders in connection with the kidneys or intestines.

The St. Leon Water Co., have a large hotel at the Springs, and it is a favorite resort of Montreal and Quebec people, and is especially patronized by the French.

As far as I have been able to find out there are very few of the mineral waters of the Province that may be classed distinctively as "table waters." A table water must first of all be palatable. We are all quite willing to take medicine when we require it, but when we are well we like what we drink to be pleasant to the taste. While this water must therefore be sweet to the taste and pure, in order to make it valuable, it must contain those rare minerals in such delicate proportions as to make the water a valuable tonic, and a corrective of the acidity of the blood, which is so often the result of the modern style of living.

A foreign water which has attained a world-wide celebrity on account of the possession of these qualities, is Apollinaris, which is drunk over the entire world, and in enormous quantities.

A more recent spring of a similar quality is the Johannis water, which is now being pushed very vigorously, and which appears to contain all the elements of a first class mineral table water.

The most recent discovery of a Canadian water of this description, is that known as "Radnor" water, and it is to this spring that I wish more particularly to draw your attention in this paper.

The spring, which is located at Radnor Forges, Champlain County, Quebec, was discovered on 8th September, 1893.

The circumstances which led to the discovery are worthy of mention. During the early part of the year 1893 the General Superintendent of the C. I. F. Co., reported there was an outbreak of what seemed to be a "skin disease" among the children of the village and neighborhood. The trouble seemed to be so general, that, in his opinion, there was some good cause for it. The company at once instituted a thorough investigation, sending Dr. W. H. Drummond to Radnor Forges to look into the matter. After a very full investigation he reported (his report being concurred in by the late Dr. Archibald Campbell) that, in his opinion, the trouble was to be attributed to the water supply, which at that time was obtained from the ordinary village wells. Samples of water were taken from almost every well in the village, and a thorough analysis made, with the result that the water was found to be heavily impregnated with iron, and affected by other impurities, the result of analysis bearing out the Doctor's opinion. A matter of note in connection with the investigation was that the Rev. Cure Prince of the adjacent village of St. Maurice, stated that during 28 years he had noted at least four outbreaks of skin disease, and these at intervals of four or five years.

After completing the above investigation, and finding that the waters of the subsoil could not be improved upon, even by piping water from a reasonable distance, the company finally decided to bore an artesian well. Operations were commenced in the centre of the village park. Borings were made at that point to a depth of about 354 feet, the strata through which the drill passed being first subsoil, then limestone, and thence into gneiss rock, a granite similar to that of the Highlands of Scotland. At a depth of 100 feet a strong flow of water was secured, which on analysis proved to have so much lime and chloride of sodium that it was looked upon as unfit for domestic purposes. This spring was finally closed at a depth of 354 feet, and, although the officers of the company were much disheartened by this, and by the fact that all former attempts at sinking artesian wells in that vicinity had proved failures, it was decided that one more attempt should be made. A location was selected on the company's property some distance away, at which the drill was set to work, with the result that at a somewhat greater depth in a valley, an extraordinary strong flow of water was found, apparently of great purity, its mineral qualities being from the first very marked but at the same time agreeable to the taste.

The strata through which the water passed were first subsoil, then somewhat porous shale rock, and lastly gneiss roek, similar in physical structure to that of the first location, but much darker in color. The shale is reported to have been very light, whilst the gneiss rock from which the water actually springs, is very close and hard.

A four inch wrought iron pipe was driven down into the gneiss rock, and through this the water flows to a height of about five feet above the surface of the ground. Strong pressure is indicated by the fact that from this four inch pipe the water can be lifted to a total height of twelve feet three inches through a one inch pipe.

The quality of the water seemed so good that the officers of the company decided to at once have a complete analysis made by the most competent authority in Canada, and Prof. J. T. Donald, Professor of Chemistry, Bishop's College, Montreal, was selected to make the analysis. From the very first Prof. Donald was favorably struck with the quality of the water. His report was a follows;

"MONTREAL, June 14th, 1894.

"I hereby certify that I have analysed the sample of Radnor Water received from the Canada Iron Furnace Company Ltd. and find the following results in 10,000 parts of water.

Chloride of Sodium	14.354
Chloride of Potassium	.211
Sulphate of Sodium	.210
Sulphate of Magnesia	1.262
Bromide of Sodium	.080
Bicarbonate of Sodium	1.697
Carbonate of Lime	2.940
Carbonate of Iron	Traces
Silica	.145
In 10,000 parts of water	20.899

"This analysis shows that Radnor Water is of the same class as Apollinaris and German Seltzer. Like those, it contains no excess of Sodium Chloride and Carbonate of Lime, and again, like these, it contains the valuable ingredients in such proportions that its use as a table water overcomes constipation and acidity of the stomach in a gentle and pleasant manner. And it is most important that the valuable Sodium Bromide, which is entirely wanting in the German waters named, exists in appreciable quantity in the Radnor Water, making it a most desirable tonic."

(Sgd.) J. T. DONALD.

This report was at once submitted by the Managing Director to the best authorities in Germany for their report. The following letters will show what a good opinion was formed of the water by the best experts in Germany:

Dr. E. Scott, of Frankfort-on-Main, Germany, a physician of high standing, writing under date June 23rd. 1894, says:

"The analysis of this water is very like Apollinaris, which it surpasses in its percentage of Chloride of Sodium, which is artificially added to the Apollinaris water to make it keep.

"We have in Radnor Water an agreeable drink, which can be used every day as a sort of beverage, but which also in cases of dyspepsia, typhus and kidney disease can be used with a beneficial influence, thus one is certain in drinking this water to have the advantage of not being affected with the harm-giving substances which are frequently to be found in ordinary drinking water."

Dr. Julius Lowe, Chemist of Frankfort-on-Main, the great German expert on Mineral Waters, says, under date June 21st, 1894:

"In comparing the analysis of Radnor Water with the analytical results of the springs of Seltzer and Apollinaris, I find that the Radnor contains in quantity many of the ingredients which are to be found in the Seltzer and Apollinaris water. The Radnor exceeds the Apollinaris water in its percentage of Chloride of Sodium, which is added to the Apollinaris water artificially.

"Supposing there is a sufficient yield of your springs it deserves, according to its composition, your whole attention, as far as value is concerned, and it justifies the expectation that the water of this spring can compete successfully with Seltzer and Apollinaris."

With regard to the actual flow, experiments with standard measures show the natural flow to be slightly over 30,000 gallons per day. Certainly the pressure is very great, and there is no reason to suppose that by putting on a steam pump the flow could not be increased, *i.e.* if it was found necessary to exceed the natural output.

The best test as to the permanency of the spring is that from the date of the discovery, 8th September, 1893, the water has not even for an instant showed a diminution of flow. Prof. Donald and others when interviewed in regard to this matter stated that this is about as good a guarantee of permanency as can be given.

As to the "keeping" qualities of the water, it may be mentioned that some of the water taken from the spring in its natural state has been kept in a glass for over a year, and it is as sweet to-day as when taken from the spring. The water being entirely mineral in character will "keep" without the slightest difficulty.

Since the discovery of the spring, and the use of the water by the people of the village, no sign of the sickness and trouble referred to has been seen. The water is in daily use in all their houses, and is known to be of the highest value in all cases of indigestion, rheumatism, etc.

The water placed on trial thus far has given the greatest possible satisfaction, and no better proof of its admirable qualities can be found than by testing it by the side of any of the most popular table waters. The delicacy, purity and flavor of "Radnor" water when thus compared leaves no question as to its quality.

Now in conclusion let me say that it is one thing to discover a spring of fine mineral water, and quite another thing to make people buy it and drink it. It is like a patent medicine, give it a good name, make it well known, and people will very soon ask for it. The splendid success that has been attained by such well known waters as Apollinaris, Johannis, and others, shows what can be obtained by persistently presenting to the public the merits of your spring. Make yourself sure by careful analysis and experiments that you have got the right thing, and plenty of it, and then spare no pains to let the public know this fact, and you will reap an abundant reward. There is at present room for a mineral water of the same nature as Apollinaris, for it would appear that there is actually more demand for it than can be supplied direct from the original spring.

I venture to prophesy for "Radnor" water a world-wide fame, founded not on advertising and puffing, but on the merits of the water itself.

The Geological Survey of Canada and Its Operations.

By R. W. ELLS, L.L.D., F.R.S C., Ottawa.

It has been suggested to me that, to those of our members who live in this city where the Geological Survey had its first location, as well as to many throughout the several provinces of our Dominion, some facts relating to the work of such a department, as annually carried out might be of interest. The question has been often asked, what is the work of the Geological Survey? what does its staff find to do year after year, and what great purpose does it serve in the country's progress and welfare? To discuss this subject fully would require a very long chapter, but I hope to be able to lay before you a few ideas regarding the general character of this work that may, to some extent at least, be an answer to the question propounded.

And first of all as to its history. The Geological Survey of Canada, whose operations have now extended to every part of the Dominion, has had an existence of fifty-two years, and while it may seem almost superfluous to devote any time to the story of its inception, it is possible there may be some present who are not perfectly familiar with the early struggle and dissappointments, which attended the efforts of those who were desirous of seeing such an institution in successful operation, and who firmly believed in its great utility as a factor in the advancement of the interests of the country. As far back then as 1832 a petition, asking for pecuniary assistance in carrying on a geological and statistical survey, was presented by Dr. Rae to the Lieut.-Governor of the Province of Upper Canada; but, though strongly recommended by that gentleman, it was not even entertained by the committee of supply. In December of the same year the York Literary and Philosophical Society also forwarded a petition for the same purpose which met with a like fate. In 1836 a committee of several gentlemen was appointed by the government to report on a plan for a general survey of the province, which report was presented, but no further action taken in the matter. On motion of the committee of supply it was then resolved that an address be presented to Sir F. B. Head, the Lieut.-Governor for the time, with reference to the practicability of the desired Survey. This, however, failed to go any further, and in December of the same year, a Mr. Dunlop gave notice of an address to the King, praying for a grant of wild lands to defray the expenses of a geological survey, which application also met with the same fate as its predecessors, and the matter was thenceforth dropped till the union of the Provinces of Quebec and Ontario in 1841.

In that year the Natural History Society of Montreal through Mr. Benjamin Holmes and the Literary and Historical Society of Quebec through Mr. Henry Black, again petitioned for aid to carry out a Geological Survey. The consideration of these petitions was taken up by the government, and on the motion of the Hon. S. B. Harrison, the sum of £500 sterling, for the purpose of such a Survey was included in the estimates. As a result of this action, early in 1842, the advisability of appointing a geologist for the work was considered, and the matter was referred to Sir Chas. Bagot, who was then Colonial Governor for the time, to Lord Stanley, then Secretary of State for the Colonies, by whom on the recommendation of Sedgewick, Murchison, DelaBeche and Buckland, the position was offered to Sir Wm. Logan in September of that year.

Logan, who was in England at that time returned to Canada in the fall and proceeded to Kingston, then the seat of Government. Here the question of an assistant was discussed and, on the recommendation of DelaBeche, the services of Mr. A. Murray, a gentleman who had been educated for the navy but who had served for some time on the Ordinance Survey of Britain, were secured. Murray was already to some extent acquainted with Canada, having resided here for several years, and served as a volunteer, also, in the rebellion of 1837. The personal acquaintance of these two men, who have rendered such signal service to this country from a scientific standpoint, began in the winter of 1842-43, and the friendship then established continued unbroken till the death of the former in 1875.

Limited as was the area of Canada fifty years ago as compared with the enormous extent of territory now included under that name—the inception and carrying out of a plan of survey such as Logan contemplated was not a thing to be lightly entered upon. Great portions of the country were accessible with difficulty, means of communication were slow and expensive, and the amount of money at his disposal, and the staff necessary for the work were lamentably small. With characteristic energy he addressed himself to the task, and soon formulated a scheme for the carrying on of the explorations required. In the spring of 1843 Logan, who had spent the winter in England, again returned to Canada, reaching Halifax in May, whence he determined to make the journey overland through Nova Scotia, New Brunswick and Quebec in order to obtain some preliminary ideas as to the structure of that section. It was on this trip that his first work was done in Nova Scotia, and particularly in connection with his famous Joggins Section, of which it has been truly said that "it forms a remarkable monument of his industry and power of observation." The remainder of the season was devoted to the study of the Carboniferous and underlying rocks of Northern New Brunswick and of Gaspé where a series of elaborate measurements were carried out similar to those of the Joggins Sections. The conclusions then arrived at by Logan with regard to the value of these so called coal-fields in New Brunswick and Gaspé were to the effect that no deposits of that mineral could even be found there in workable quantity, and the views then expressed have ever since been accepted as definite, thus preventing the useless expenditure of capital in that direction.

While Logan was thus devoting his energies to the working out of the structure of the Eastern Provinces, Murray, his assistant, had been equally assiduous in his labors in Western Canada, and in the preface of the Geol. Can., 1863, Logan says that "he (Mr. Murray) has worked out nearly all that is known of the distribution of the rock in that division of the province." In addition to his work in the field Murray also accompanied Logan in the first great exploration of the Gaspé Peninsula in 1845, during which surveys were made of the Shick-Shock Range and of most of the larger streams that traverse the section.

The Geological Survey can now be said to have been fairly launched, though under circumstances not the most satisfactory. At the Session of the Legislature of 1845-46 the sum of £2,000 was voted for carrying on the work, and in the ensuing year this amount was granted for a period of at least five years. The bill upon which this grant was made was designed by Sir William himself and was to the effect that a certain number of competent persons should be appointed. "Whose duty it shall be, under the direction of the Governor in Council, to make an accurate and complete geological survey of the province and to furnish a full and scientific description of the rocks, soil and mineral, which shall be accompanied with maps, diagrams and drawings, together with a collection of specimens to illustrate the same; which, maps etc., shall be deposited in some suitable place, which the Governor in Council shall appoint and shall serve as a provincial collection, and that duplicates of the same after they have served the purposes of the Survey, shall be deposited in such literary and educational institutions of the Eastern and Western divisions of the provinces, as by the same authority shall be deemed most advantageous."

The first chemist appointed by Sir William was the Count de Rottermund, a student of Le Ecole Polytecnique, Paris; whose connection with the official staff was but brief as he voluntarily resigned the position in 1846. The vacancy thus created was speedily filled by the appointment of Dr. T. Sterry Hunt, who at that date was acting as chemist to the Geological Survey of Vermont. This appointment was a particulary happy one, and for nearly twenty-five years, in his capacity of chemist and mineralogist, Hunt built up, not only for himself but for the Canadian Survey, a reputation which is world wide.

With the exception of the department of Palaeontology the Survey was now comparatively well equipped and ready to carry on the purpose for which it was established. The staff was small but the material good, and exploration went rapidly forward. In 1847 Mr. Jas. Richardson was added, and in the course of over thirty years work, examined many portions of the Dominion from the Straits of Belle Isle to the islands in Queen Charlotte Sound on the confines of Alaska. Other persons have been added from time to time as the necessities of the Survey demanded or the funds as its disposal permitted. In the branch of palaeontology it was however found necessary for some years to send abroad for determination, many of the valuable specimens which were rapidly accumulating; and among those who rendered valuable services in this way were Prof. Jas Hall, of Albany, N.Y., and Messrs Jones and Salter of the English Survey. This difficulty was at length overcome by the appointment in 1856 of Mr. E. Billings of Ottawa, whose love of scientific work in this line was such as to lead him to lay aside his chosen profession of the law, and, at the request of Logan, to attach himself to his small but zealous band of workers. Of him also it may be truly said, that much of the great reputation the Survey has acquired, both at home and abroad, is due to his indefatigable labors The appointment of Mr. Robt. Barlow, formerly of the Royal Engineers, as chief draughtsman shortly after completed the official equipment of the staff at that time. The work of exploration was carried on for some years by the employment of specialists who were elected to undertake the examination of particular mineral locations, and whose reports were of great value, only what was regarded as permanent employees of the staff who carried forward the work along certain regular lines laid down by the Director himself. The particulars and results of these explorations will be found in the preface of that great volume the Geology of Canada, 1863, in which the leading features of the Survey's operations to that date are admirably presented.

In connection with this volume and designed to accompany it, the great Geological Map of Canada and the adjacent Northern States was published in 1866; of which it may be rightly said that no more beautiful work of the kind has ever been presented by this or any other Survey; a work entailing an enormous amount of labor and reflecting the greatest credit upon all engaged in its compilation and in the delineation of the exceedingly complicated geological lines there laid down. This great work will always stand as the map *par excellence* and will always be pointed to with a feeling of pride, not only by the members of the Survey itself but by every Canadian who feels an interest in the suceessful carrying out of the study of geological science in our own country. During all these years of hard work in the field by the officers and staff, other matters involving quite as serious labor, were being presented from time to time. The great exhibitions at London, Paris and Dublin, to which the Survey sent large and characteristic collections, both of rocks and minerals, which set forth in an attractive and forcible manner the great natural wealth of the country was productive of much good, but involved an immense expenditure of time and energy. The museum and offices were constantly visited by scientific men from all parts of the world who might be passing through the city, as well as others seeking information on various points; and from the old workshop on St. James and St. Gabriel Streets, much work of very great importance in connection with the development of Canada's mineral resources was produced. But, in 1867, the Confederation of the Provinces opened new fields for the Surveys operations, and the somewhat small amounts hitherto granted were soon found to be inadequate to carry on the work over such greatly extended areas. In the meantime the Survey had lost one of its original members by the retirement of Mr. Murray, who at the request of the Newfoundland Government had undertaken the Survey of that colony. The staff had gradually been enlarged, but the great strain to which the Director had for some years been subjected began to tell upon him severely, and in 1869 Sir William Logan felt it incumbent upon him, in view of the greatly increased area to whieh the operations had been extended, and the interest he felt in solving certain puzzling problems of structure in the Province of Quebec in which he had for some years been especially interested, to lay aside the direct management of the Surveys and to seek a successor. His resignation took effect in that year, and with this date we may close the first stage of the Geological Survey operations. Dr. Selwyn, a gentleman of very extensive experience, not only in the Geological Survey of England and Wales, but as director of the Survey of the great Colony of New South Wales, was chosen as his successor, and with this appointment we may enter upon what one may style the second period in the Surveys history.

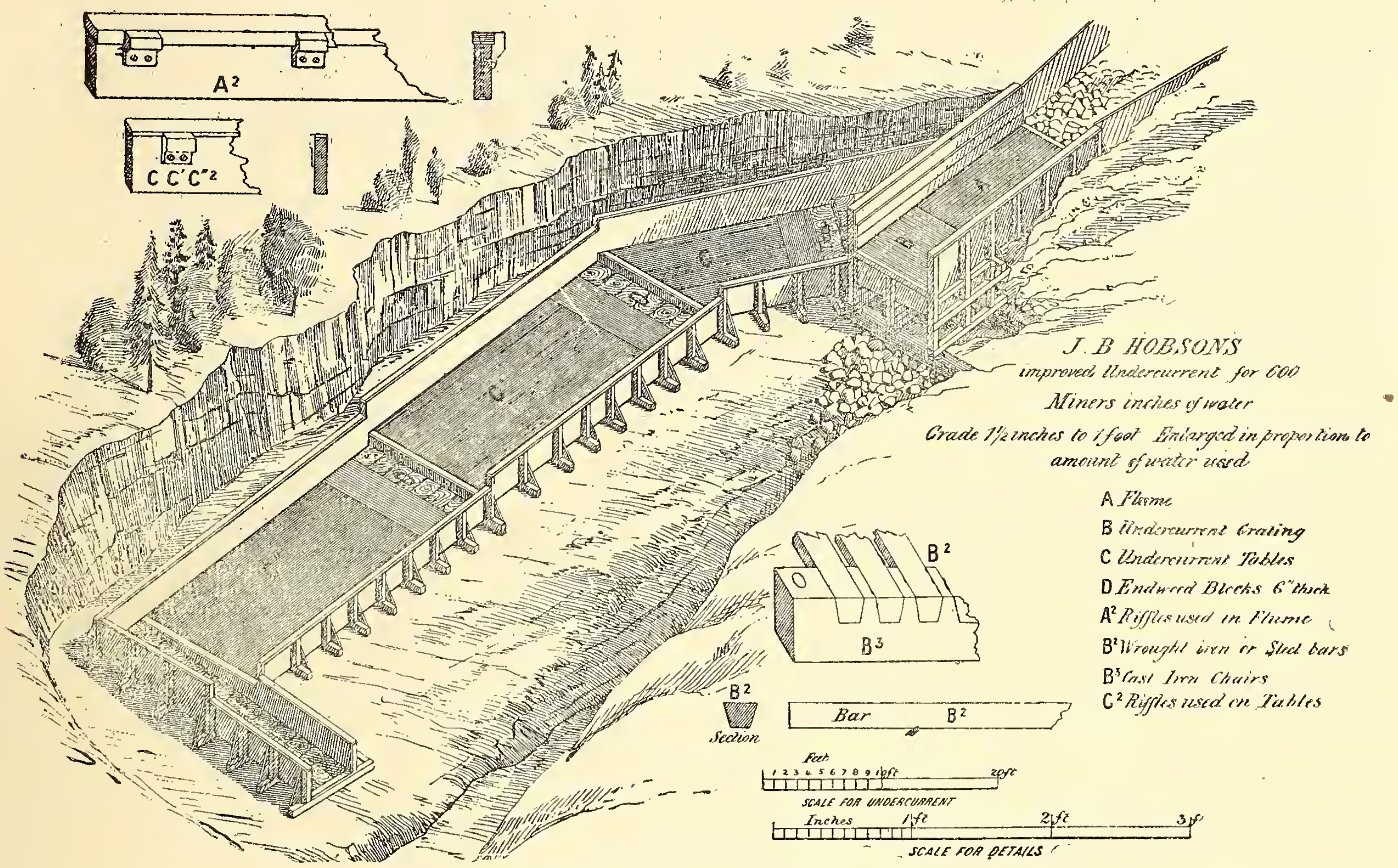
Hitherto the work had for the most part been confined to the Provinces of Ontario and Quebec. Henceforth it had to include in its scope not only the distant areas of British Columbia, the great plains of the North West Territories, the rugged masses of the Rocky Mountains and the wide expanse of the Peace and MacKenzie Rivers basins, but the Maritime Provinces of Nova Scotia, New Brunswick and Prince Edward Island as well. It can readily be seen therefore that the task now entered upon by Dr. Selwyn was one of no small magnitude, especially when we consider that of our own great western areas our information was of the most meagre kind, not only as regarded its geological structure, its mineral wealth, its agricultural capabilities, and its natural history and climatic conditions. New and more detailed investigations had also to be undertaken in the older provinces, in connection with the metamorphic and metalliferous rocks, and in the great country lying between Lakes Huron and Superior and the Hudson and James Bays. It is probably not saying too much, nor, I trust, will it appear to savor of adulation, if we state that probably no enterprise so great as the complete Geological and Natural History Survey of a country embracing over 3,000,000 square miles. was ever undertaken by by a staff so small in numbers or carried on with an expenditure so insignificant as was attempted by the Geological Survey of Canada. And it is well within the bounds of truth, if we say that to the work of the members is due, in very large part, much of the information we now possess as to the greatness of the country's resources, both agricultural and mineralogical, between the waters of the Atlantic and the distant shores of Labrador on the East and the distant shores of the Arctic Ocean and the boundary of Alaska on the north and west. It will scarcely be necessary to mention individual names in this connection. The various officers of the staff and their various fields of labor are too well known to require any special personal reference when addressing a Society such as this.

It would be impossible in the time at our disposal to give any detailed account of the work or the Survey during the last quarter of a century over such an enormous area, and we can only summarise the result of the investigations of the several parties in the briefest manner. Thus, in the East the carefully detailed maps of Cape Breton and Eastern Nova Scotia have been presented to the public and have received the highest praise. We have now also a very good general idea of the structure of the other portions of the province including the horizons and distributions of the great gold-bearing series which extends from Yarmouth on the west to Guysborough on the east. The structure of the great coal fields of Cape Breton, Pictou and Cumberland have been carefully studied, and the geological horizons of the ores of iron and manganese which are of very great importance in connection with the future development of the country, have been clearly and satisfactorily determined. The geological maps of both New Brunswick and Prince Edward Island have been completed and the complex question of structure in the southern part of the former province which for years was of an exceedingly puzzling character has been thoroughly solved. The outlines of the great central carboniferous basin, occupying an area of over 12,000 square miles in the province, have been carefully determined, and its presumptive value from the economic standpoint ascertained, while some of the most important work in Canada, in connection with the palaeontology of the oldest fossiliferous formations, has been and is still being carried out with the greatest care.

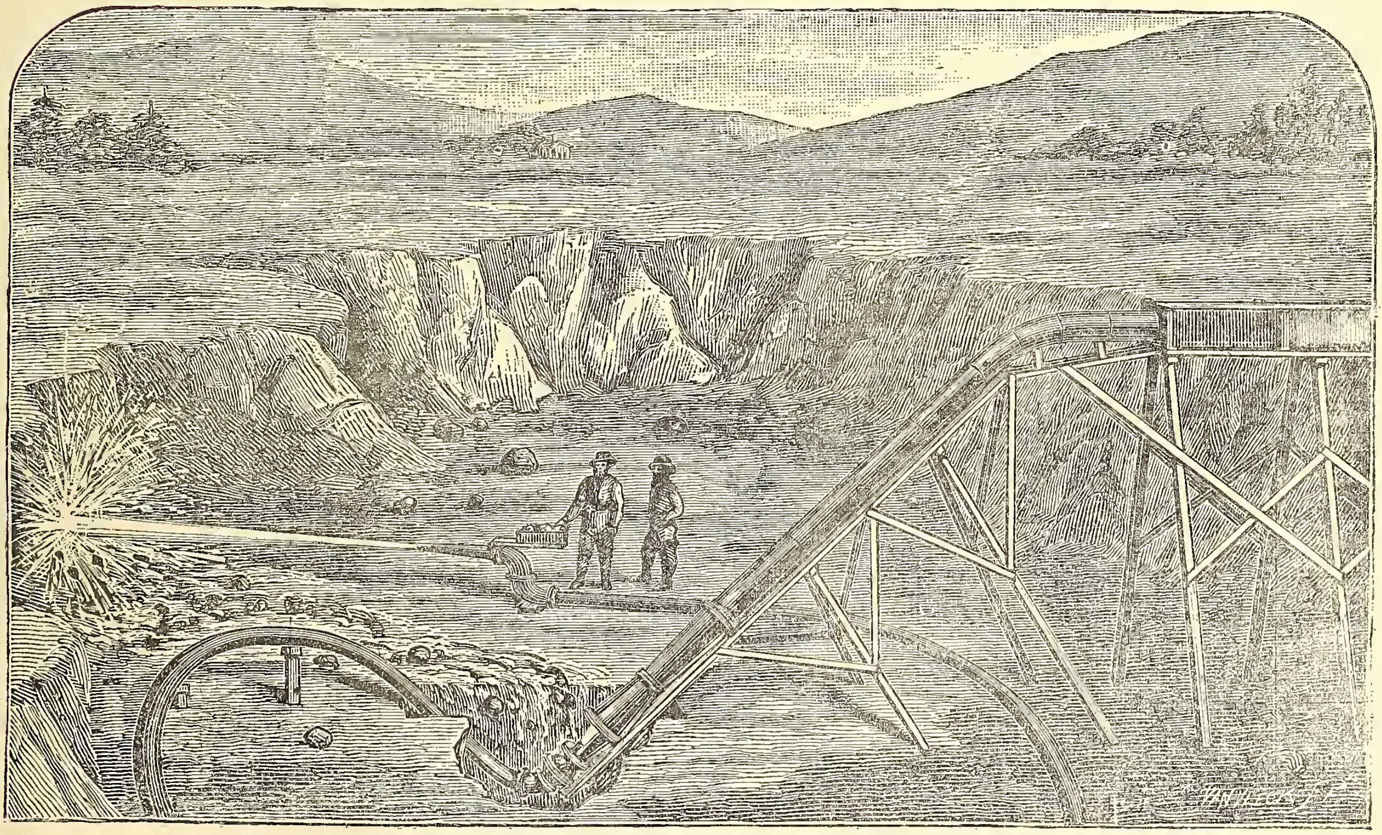
In Quebec East the great problem of the age and stratigraphical relations of the various members of the "Quebec group," a problem which for more than forty years has engaged the attention of geologists not only of Canada, but to some extent of the United States and Europe as well, has, it is hoped, been placed on a satisfactory basis of settlement. While to the north of the St. Lawrence the mysteries of the great region of the Mistassini have been cleared up, and great progress made in the study of the Laurentian rocks north of the St. Lawrence and Ottawa rivers. The great wilderness country between the Ottawa and James Bay has been traversed in many directions along the great natural avenues of lake and river, by which alone this otherwise pathless area can be explored. Concerning the great extent of country about the Hudson and James Bays as well as of the great inland plateau of Labrador, we have now very clear ideas, not only of its geology and mineral wealth, but also of its fauna and flora, and of its adaptability for settlement; while much of its topography has been carefully mapped by means of instrumental surveys.

The economic problems of the occurrence of iron, gold, phosphate, asbestos, copper and mica have also been investigated and much valuable information relative to their distribution, their geological position and the manner of their occurrence has been obtained. Some of these have already appeared in the publications of the Survey or in the Bulletins of the several scientific societies in Canada and the United States. In Ontario while a large amount of detailed work has been carried on in the older and more settled portions of the province tending to the more accurate determination of the better known formation and to the determination of the economic mineral wealth, much careful work of a very high order has also been done in the area north of Lakes Huron and Superior and further west, where some of the great questions as to the age and origin of the fundamental or lowest rocks of our systems, are now in a fair way of being definitely settled. The geological relations of the copper bearing series, of the great deposits of iron ores and of the gold bearing rocks of the Lake of the Woods areas, and the horizon and distribution of the nickel ores of the Sudbury district have been among the questions of the greatest economic nature. In the more settled portions of the provinces the distribution of the gas bearing strata, and the problems of the origin of the gas itself have been carefully studied, and the assertion of the great American gas expert, Ashburner, that no deposits of natural gas would ever be found in workable quantity in Canada has been thoroughly exploded.

To be Continued.



APPLIANCE FOR SAVING FINE GOLD.



HENDY HYDRAULIC GRAVEL ELEVATOR.

The Auriferous Gravels of British Columbia.

By JOHN B. HOBSON, M.E., Vancouver.

The auriferous gravels of British Columbia, like those of Central California, may be divided into two classes; first, the shallow or modern placers; second, deep or ancient river placers. These terms indicate the characteristic difference that exists between the two classes of placers.

SHALLOW OR MODERN PLACERS.

These placers are superficial deposits of auriferous gravel and alluvium, formed by the modern streams that drain an auriferous region, and are designated as river, bar, bench, gulch, creek or ravine diggings, according to their topographical position.

The placers of the modern rivers of California are practically exhausted. Those of British Columbia are not by any means exhausted.

The shallow placers known as bar, creek and gulch diggings, have been, so far as known, extensively worked since the Fraser River and Cariboo gold excitements about 1857.

The most accessible of the above named placers have been pretty well worked out in the districts I have examined.

But the vast accumulations of auriferous gravel on the benches along the Fraser, Quesnele, Horsefly and other modern streams examined are practically unexplored. These can be worked by hydraulic process wherever water can be secured and all other necessary conditions are reasonably favorable.

The deep placers of the modern streams, that is to say, the auriferous gravels lying below the water level of the modern streams, have been worked to some extent in the vicinity of Barkerville, but immense areas remain to be explored, and will in all probability be profitably worked in the future by aid of modern appliances.

The deep modern placers can be exploited either by shaft, and worked by what is known in California as the drifting process, or by the hydraulic elevator process. In other words a shaft is sunk to bed rock, and the bottom stratum of auriferous gravel is breasted out, hoisted to the surface, washed in ordinary sluices and the gold recovered.

Wherever an abundant supply of water can be obtained and delivered at the mine under sufficient head or pressure, as it is called by California miners, the auriferous gravels lying below drainage can be successfully and profitably worked by the hydraulic elevator. Figure 4 represents a mine in operation by hydraulic elevator process.

THE DEEP PLACERS OF THE ANCIENT RIVERS.

The deep placers of the ancient river system of the tertiary as seen in British Columbia, are similar in character, but so far as I have been able to determine, far more extensive and richer in their gold tenure than those of the most favored districts in Central California, where gravel deposits which contain from three to five cents per cubic yard in gold are considered rich and yield as profit from twenty to fifty per cent. of the gross output when worked by the hydraulic process.

Figure 1 is a sketch showing a geological section of an ancient river channel deposit of auriferous gravel in California, and shows the method of exploitation and working by the hydraulic process.

The top gravel A is usually free, and yields to the force of the hydraulic streams, and is easily worked out through the sluices in tunnels E, F and G.

The blue gravel stratum B is usually indurated to such a degree that it becomes necessary to disintegrate it by bank blasting before the gold can be liberated and recovered. This is accomplished by driving a system of drifts under the bank and exploding large quantities of powder therein—one hundred thousand pounds of powder have often been exploded in one blast at some of the larger hydraulic mines in California. By this means immense quantities of the richer gravels are disintegrated and very profitably worked.

The bottom stratum D is in places indurated to such a degree of hardness that it cannot be worked by hydraulic process without loss of a large percentage of the gold inclosed in the indurated mass which goes to the dump in lumps. When this condition occurs, the bottom or rich stratum on the bedrock is drifted or breasted out, worked in stamp mills in the same manner as quartz, and the gold recovered by amalgamation.

Similar conditions accompany some of the deposits of the ancient rivers of British Columbia as those illustrated in figure 1. Figures 2 and 3 represent geological sections at the Cariboo Hydraulic mines.

Water is abundant in all the districts I have examined, and can be brought on to the deposits in shorter canals and at much less expense than is possible in California.

In California there is invested one hundred millions of dollars in hydraulic mining enterprises, and prior to the inhibition of that industry, on account of damage done by debris to agricultural lands and navigable streams, the annual product in gold amounted to about twelve millions of dollars, about one-half of which resulted in profits.

The auriferous deposits of California remaining unworked are estimated at 2,108,875,000 cubic yards. The gold tenure of these gravels vary from one to thirty cents per cubic yard, and the total gold content estimated at about $500,000,000.00.

I have seen in British Columbia, included in the Yale, Lillooet and Cariboo districts, three times the area of auriferous deposits that are known to exist in the whole of the State of California.

The British Columbia gravels that I have examined, and that may be considered available for hydraulic working, yielded results varying from one cent to $1.50 per cubic yard, and as a whole average richer than any I have seen in California.

In some properties examined, I sampled streaks, some of which were on bedrock and others 150 feet above the bedrock, that yielded prospects varying from $2 to $36 per cubic yard. We have no such rich deposits in California.

The exploitation and equipment of hydraulic mines is expensive, and large sums of money are required to provide water supply and hydraulic plant, to get the mines opened and placed on a paying basis.

For this reason great care should be exercised by those intending to engage in such enterprises. Competent engineers should be employed to investigate the source of water supply, determine the available gradient for sluices, dump for debris and the gold tenure of the gravel. The absence or insufficiency of either of the first three of these conditions means the failure of the enterprise to prove remunerative.

A company of gentlemen in Montreal have undertaken the equipment of two large hydraulic mines in Cariboo, the Horse Fly Hydraulic Mine and the Cariboo Hydraulic Mine, which will soon be on a basis for profitable production.

I do not hesitate to predict that the day is not far distant when the gold output from the auriferous placers of British Columbia will not only surprise Canadians, but will astonish the civilized world.

I will refer briefly to some of the principles involved in the working of hydraulic mines, and to the origin of the hydraulic process in California.

The exhaustion of the shallow placers led to the discovery of the deeper deposits of the ancient river system. The shallow placers were, of course, rich like those of Cariboo, and, as they were exhausted, the miners attacked the deeper deposits to work their shallow edges. Only a small supply of water was required, and the great richness of the bed rock stratum and concentrated edges or rims made the work profitable to individual labor, with the easily obtained and limited supply of water; but as the depth of the superincumbent mass of poorer top gravel increased, the results decreased and the individual miner was forced to abandon his effort and depart for shallower and richer fields.

This was the condition of California in 1857. This is the condition of the auriferous regions of British Columbia to-day—the shallow placers exhausted—the deep placers unexplored. Vast areas of the best auriferous earth in the world awaiting the energy of the prospector to explore and locate, and the courage of capital to develop and place on a basis for gold production.

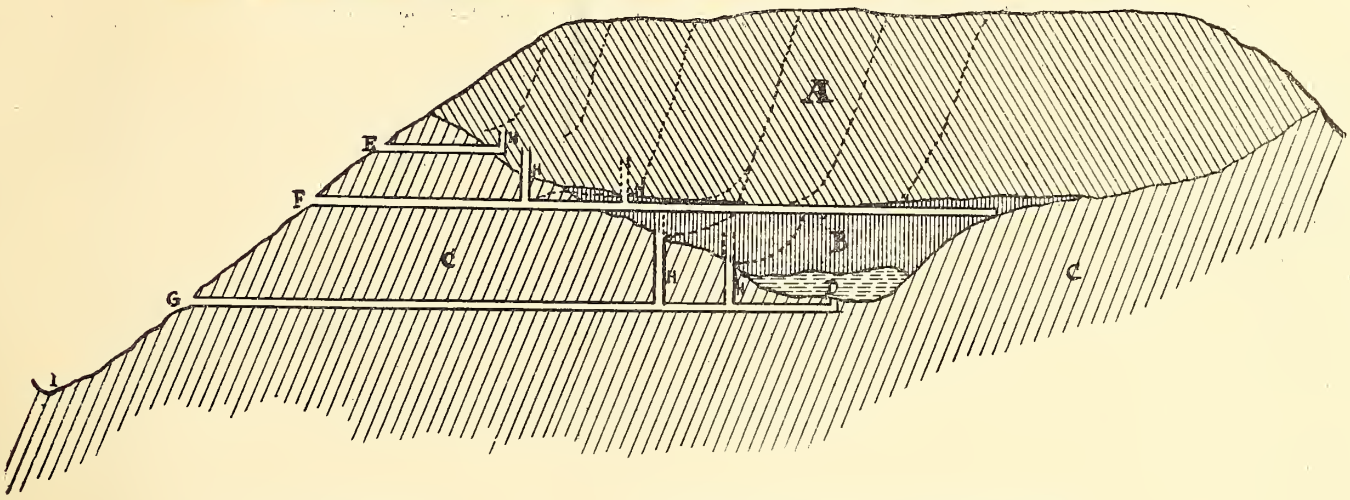
The gravel banks or deposits of debris and alluvium of the ancient rivers are the most favorable form of deposit for the operation of hydraulic mining, owing to the even distribution of the gold throughout the mass of gravel and the great depth of material.

As the early or pioneer miners exhausted the rich shallow placers in the ravines and gulches, they turned their attention to the deposits of the ancient rivers, working off their thin edges with the limited supply of water, but sooner or later abandoned the attempt, as the amount of the material which they could remove in a day with a small quantity of water, without pressure, would not pay; they had, however, discovered two important facts, viz: That their want of success was mainly due to the want of a large supply of water delivered under pressure to enable them to remove

Table Showing Results of Working a few Well Managed Mines in California.

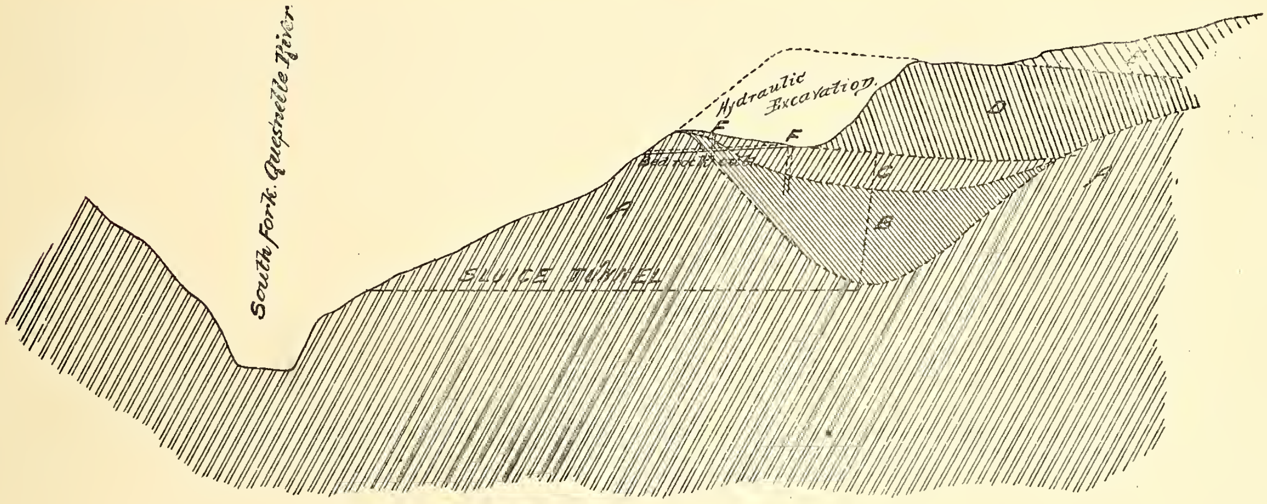
Name of Mine	Locality.	Quantity water used in miners inches.	Height of Bank in feet.	Head or pressure of water in feet.	Grade of sluices in inches to 12 feet.	Cubic yds. of gravel moved per inch of water used in 24 hrs.	Average yield in cts. and fraction of cents per cubic yard.	A'ge yield in cents & fraction of cents per inch of water used in 24 hours.	Cost of min'g per cubic yard in cents and fraction of cents. Water	Labor &c	Total cost of moving per cubic yard in cts. and fractions of cents	Net profit per cubic yard in cents and fraction of cents.	Net profits in cents and fraction of cents per miners inch of water used in 24 hrs.	Remarks.
French Hill	Stanislaus Co.	2150	30	70	3½	$1\frac{14}{100}$	12	13	$\frac{8}{10}$	$5\frac{1}{10}$	$5\frac{9}{10}$	$6\frac{1}{10}$	$6\frac{1}{10}$	This Company owns water which costs about 1 cent per inch
North Bloomfield......	Nevada Co.	3000	260	300	6½	$4\frac{17}{100}$	$6\frac{6}{10}$	$27\frac{5}{10}$	$\frac{74}{100}$	$2\frac{45}{100}$	$3\frac{19}{100}$	$3\frac{41}{100}$	$24\frac{31}{100}$	This Company owns water which cost 3 cents per inch.
Independence Hill....	Placer Co.	500	150	375	12	24	3	72	$\frac{41}{100}$	$1\frac{09}{100}$	$1\frac{5}{10}$	$1\frac{5}{10}$	36	Both these companies purchase water at 10 cents per miners inch per 24 hours.
Big Bonanza..........	Placer Co.	1500	Top Gravel 250	300	8	14	5	70	$\frac{71}{100}$	$1\frac{79}{100}$	$2\frac{5}{10}$	$2\frac{5}{10}$	35	

Sketch Shewing Section of Gold Bearing Gravel Deposits of Ancient River, Placer County, Cala.



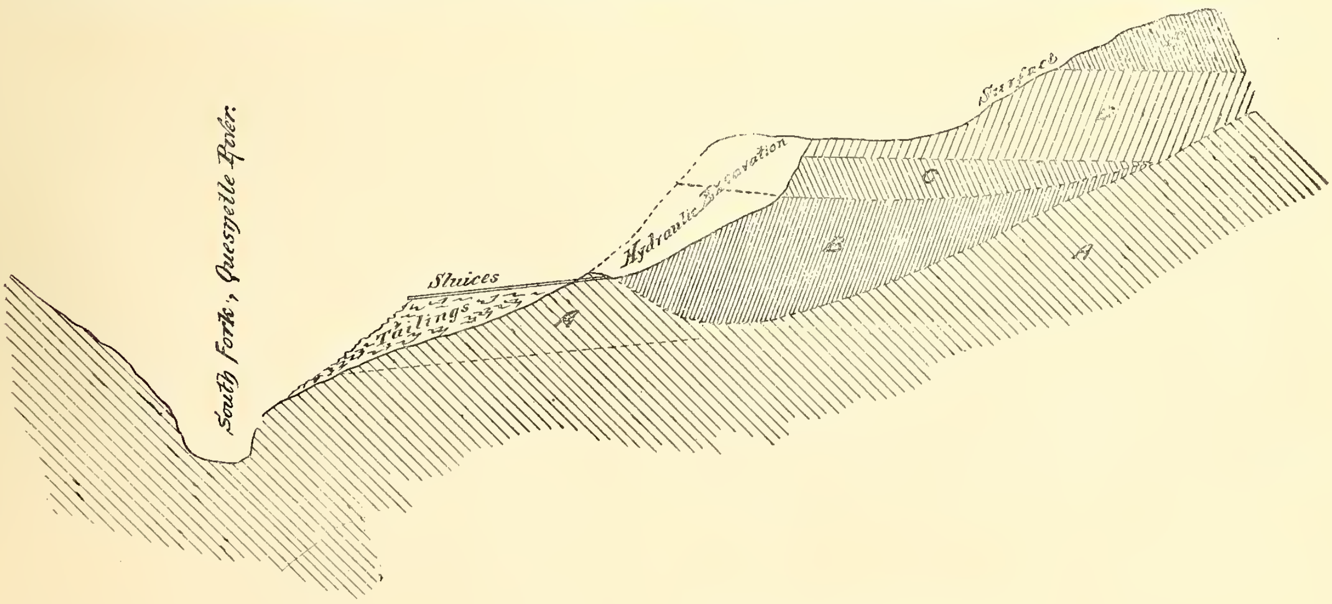
A—Auriferous Top Gravel
B—Cemented Blue Gravel
C—Hard Slate Bed Rock
D—Channel of Ancient River
E—First Sluice Tunnel
F—Second Sluice Tunnel for working Top Gravel
G—Third Sluice Tnnnel for working Blue Gravel
H, H, H—Shafts connecting Hydraulic Pit with Tunnels
I—Bed of American River
Dotted Lines—Hydraulic Excavation

Sketch Showing Geological Section on Line Across Workings in the China Pit, Cariboo Hydraulic Mine, B.C.



A—Bed Rock
B—High Grade Auriferous Gravel
C—Indurated Boulder Clay
D—Low Grade Auriferous Gravel
E—Boulder Clay rearranged in Places.

Sketch Showing Geological Section on Line Across Workings South Fork Pit, of the Cariboo Hydraulic Mine, B.C.



A—Bed Rock
B—High Grade Auriferous Gravel
C—Indurated Boulder Clay
D—Low Grade Auriferous Gravel
E—Boulder Clay rearranged in Places
F—Prospect Shafts

large quantittes of material. As before stated, miners also discovered that as the quantity or volume of water employed was increased, as also the pressure under which it left the delivery pipes, they accomplished better results, and that under favorable circumstances, gravel which contained only a few cents per cubic yard could be made to pay handsomely, and therefore every effort was made to secure these conditions. Out of these efforts has arisen the modern system of hydraulic mining, which I will briefly endeavor to explain.

HYDRAULIC MINING.

Hydraulic mining is accomplished by utilizing the power of water, and the gradient afforded by the fall or difference of level between the auriferous deposits and the dumps into which the debris resulting from the mining operations must be deposited.

The power of the water depending on its volume and the head or pressure under which it can be delivered at the working floor of the hydraulic excavation, it is therefore most essential that the water ditch or canal should be at a high elevation above and as near as possible to the deposit of gravel to be mined. The first condition insures a great hydrostatic pressure, and the second a reduction in the length and cost of the sheet iron or steel conveying pipes.

It has been demonstrated that one thousand miners' inches of water can be disharged under a head or pressure of 300 feet through a six inch nozzle, with a velocity f about 140 feet per second, and in a volume of about 1650 pounds during the same eriod of time.

Such a volume of water, in the form of a jet uninterruptedly impinging upon a bank of auriferous earth or gravel, having, as it does, about one-tenth of the velocity of a projected cannon ball, must necessarily do great execution, and produces the caving of an ordinary gravel bank without the aid of explosive blasting.

The greater the gradient given to the conveying or mining sluices, the greater will be the duty of the water employed to remove the auriferous material from the excavation to the dumps.

The separated gold is caught between the riffles placed in the mining sluice bottoms, and held there by the use of mercury until it becomes desirable or necessary to recover it therefrom. When the amalgamated gold is cleaned up from the sluices, it is retorted to distil over and recover the mercury and the remaining gold retort, as it is called, is melted into bars and sent to the mints for coinage.

Gold-saving appliances, called under currents, are now in general use in California for recovering fine flour gold that could not be recovered in the ordinary riffled sluice.

Figure 5 represents an hydraulic mine in operation.

Figure 6 represents an improved under current.

As it is proposed to remove immense masses or quantities of gravel, only utilizing an infinitesimal portion of the same, it is first necessary to see that there is abundant room to dump below the mine the vast quantities of debris to result from the entire working of the mine, for if this debris was permitted to accumulate near the end of the sluices, it would soon choke and cover the gold-saving appliances. It next becomes necessary to ascertain the quantity of water available, and the head or pressure under which it can be delivered at the mine.

The amount of work that can be accomplished depends greatly on these two contingencies; it is self-evident that to remove a large amount of material composed of sand, gravel, cobbles and rock, a considerable quantity of water is necessary, and if it is not obtainable, the operations of hydraulic mining cannot be carried on successfully. The amount of water used for operating an hydraulic mine varies greatly in different ocalities, viz: from 200 inches to several thousand inches daily, 500 to 1,500 inches being considered a fair volume to be discharged through one machine or giant, while the work accomplished by the quantity of water used is greater as the pressure under which it is discharged in the mine, and the grade of the sluices for conveying away the gravel increases.

As water used by miners is always measured by the inch, and all calculations of the value of gravel are best estimated by the duty of an inch of water, it becomes necessary to fully understand what an inch of water is, as well as its power to remove gravel under different conditions. The standard of measurement varies slightly in different mining districts, but the usual method of measuring water now in use in California is to discharge the water through a four-inch opening while the water in the measuring box stands four inches above the top of the discharge opening; thus an opening 125 inches long and four inches high will discharge 500 miner's inches, one inch being equal to a discharge of about 2230 cubic feet in 24 hours. As an illustration of the advantage of estimating the value of a bank of gravel by its yield in gold per cubic yard, and the number of yards of gravel removed in 24 hours per inch of water used, where the water was used under different heads and the sluices under different grades, see the annexed table showing the results of the working of a few well managed hydraulic mines in California.

By reference to the table, it will be seen that the mine yielding the least amount of gold per cubic yard gives the largest returns to its owners, for the reason, as the table shows, that the water was delivered at the mine under the greatest head, and the sluices for running away the gravel have the heaviest grade. It is evident that the value of the gravel per cubic yard is not a good standard, and for this reason the power of a definite quantity of water and a heavy grade in the sluices have been substituted to accomplish the desired result.

If grade for sluices, dump for debris, and a sufficient quantity of water are available, it is then worth while to ascertain whether the gravel will pay to wash, and under this head it will be easy to show, by reference to many operations on a large scale, that the cost of mining and washing a cubic yard of gravel may be brought to exceedingly low figures, but it is almost impossible to say what it should contain to be remunerative, as so many elements and conditions enter into the calculations.

The price of water sold to miners in California for hydraulic mining varies from ten to twenty cents per inch per twenty-four hours, and this item must always influence the result, as it is the main one, but at the same time the actual cost of water to the ditch owner is not more than from two to five cents per inch, so that the ditch owners can afford to work gravel on their own account that would not yield more than one or two cents per cubic yard, considering other conditions, such as grade for sluices and dump for debris being reasonably favorable.

It is hoped that this brief sketch, which deals only with the principles employed and not with their individual application, will give an intelligent idea of hydraulic mining, which promises to become an important industry in Britiih Columbia.

Had I the time, Gentlemen, I would willingly enter more into details of working and equipment of deep gravel drift and hydraulic mines.

I thank you for your patience and attention, and hope to have the pleasure of meeting your Association at some future time.

Notes on Hydraulic Mining in British Columbia.

By Dr. G. M. Dawson, C.M.G., Director, Geological Survey of Canada.

[During the past summer Dr. Dawson visited the more important new works of this kind in British Columbia, of which a description was given, as well as some discussion of the geological conditions and age of the auriferous gravels, in an address to the members of the association of which the following is a synopsis.]

Although hydraulic mining has long been practised on a small scale, particularly in the vicinity of the old gold mining camps in the Cariboo district, it is within the past two years only that really extensive operations of this kind have been initiated. Of these the most important are the Cariboo Hydraulic Company, operating on the south fork of Quesnel river, the Horsefly Hydraulic Company, on the river of the same name, and the Van Winkle Hydraulic Company, near Lytton, in the Fraser valley.

The two first mentioned companies are under the management of Mr. J. B. Hobson, to whose practical knowledge and advice based upon long experience in California the renewed interest in mining in the Cariboo district is largely due. Both of these companies will be in full operation next spring, and it is anticipated that they will be closely followed by many other enterprises of the same kind. All these should be undertaken, however, only after thorough prospecting, for although the Cariboo district abounds in streams and lakes at many different levels, the initial expenditure in obtaining a sufficient supply of water with the requisite head is generally very considerable. In order to give an idea of the character of the operations now in progress, the following particulars relating to the Cariboo and Horsefly companies may be cited.

The property of the Cariboo Hydraulic Mining Company is situated on the south side of the south fork of Quesnel river, about three miles above the village of Quesnel Forks. It comprises several claims, and is believed to cover about 8,500 feet of an old high channel of the river, separated from the modern deep and canon-like river gorge for a considerable part of its length by an exposed rocky ridge, known as French Bar Bluff. Near the lower end of the property, on Dancing Bill Gulch, successful hydraulic mining on a small scale and with imperfect appliances has been carried on for a number of years by a Chinese company. At a distance of about 3,000 feet further east, on Black Jack Gulch, a good deal of work had been done by the South Fork Company, but without effectively reaching the richer gravels, which are below the level of the rim rock where this has been cut through. Short ditches have been made by both these earlier companies, and the exposures in their hydraulic pits afford most of the information obtainable as to the character of the deposits.

A ditch with a total length of seventeen miles and a capacity of 3,000 miner's inches has now been laid out by the present company and will be completed in the spring. This is to derive most of its water from Polley's Lakes, situated in the hills to the south-eastward. It is also I believe ultimately proposed to bring an equal volume of water from Moorhead Lake by means of a second ditch, which will be thirteen miles in length.

At the lower, or "China Pit," the bed rock of the old channel where cut by the present river bank is believed to be approximately 134 feet above the river. The head of the train of sluices near the working face is 200 feet above the same datum, while the sand box at the top of the bank is at a height of 489 feet; giving a head of water equal to about 289 feet, with ample fall for the dump, which is made direct into the river. Two monitors of five and five and a-half inches diameter of nozzle respectively, are established in this pit. Mr. Hobson estimates that the old Chinese company removed in all about 150,000 cubic yards of the bank, from which, it has been ascertained, $135,000 of gold was obtained, without the employment of mercury, or at the rate of about 90 cents per cubic yard. The scanty water supply available in advance of the completion of the main ditch enabled a run of only forty-seven hours to be made in the early summer. The mean volume of water employed was 2,000 inches, and the yield was 302 ounces.

The floor of the pit of the Old South Fork Company is about 200 feet above the present river, and the bed rock run has been found in test pits at a depth of about 30 feet below this floor, while above it on one side of the gully, is a nearly vertical face of clay and gravels about 200 feet in height. The head of water from the sand box to the present bottom of the pit is about 246 feet; but as already stated the rim rock has not yet been cut through to the full depth of the old channel. It is proposed to begin active work here in the spring.

The Horsefly Hydraulic Company's claims are situated on the Horsefly river at a distance of about six miles south of Quesnel Lake. The river was notably rich in this particular part of its length and the bars had all been worked over by Chinamen some years ago. The source of this gold was found by Mr. McCallum to be the old gravel deposit now being worked by the Company.

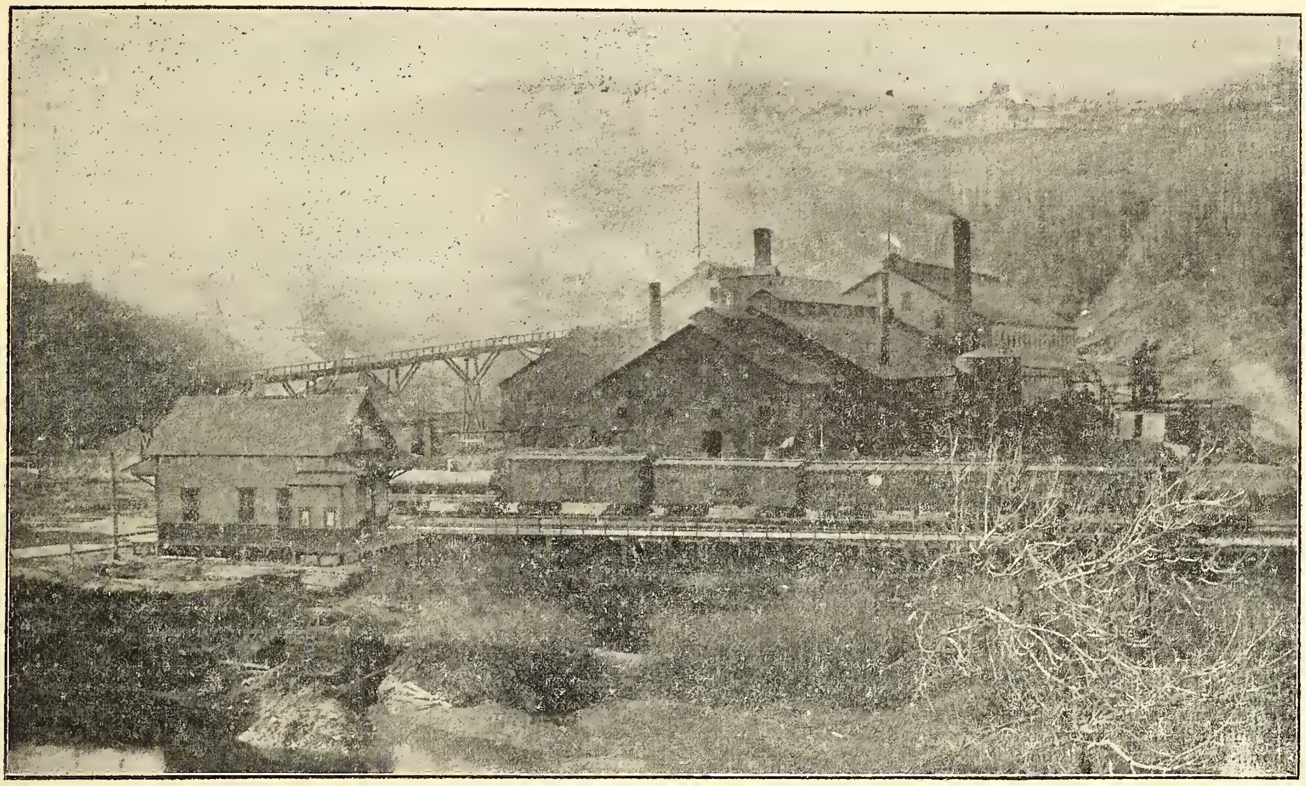
By the hydraulic system now successfully completed, water is brought from Mussel creek, a southern feeder of the Horsefly by a ditch and pipe line aggregating over eleven miles and a half in length. The ditch is about ten miles long, with a capacity of 2,000 miner's inches. The pipe line is steel, 30 inches in diameter, in two lengths aggregating 8,300 feet. There is also about 600 feet of flume. From the sand box the water is led to the pit by two lines of 22 inch pipe, each of which is intended eventually to supply the monitors. Water is delivered from the main ditch with a head of 168 feet and from the pooling reservoir with a head of 106 feet. The bed rock, constituting the floor of the pit, is about 90 feet above the level of the river and the working face (60 feet in height at its highest part) at the time of my visit, was about 560 feet back from the river bank. The dump is formed in the river itself, which is a moderately rapid stream, capable, (particularly in high water) of removing a large quantity of debris.

Respecting the actual average gold content of the gravels as worked, much has doubtless been ascertained since my visit, some $13,000 being reported as the result of the last clean up. The preliminary run made by the Company was estimated to have dealt with 21,333 cubic yards of gravel. It produced gold to the value of $5,000, or at the rate of about 25 cents per cubic yard, but about a third of the area then worked had already been drifted on bedrock by the original discoverer, rendering it probable, in Mr. Hobson's opinion, that the unworked ground would average about 40 cents. A small percentage of platinum occurs with the gold at this place.

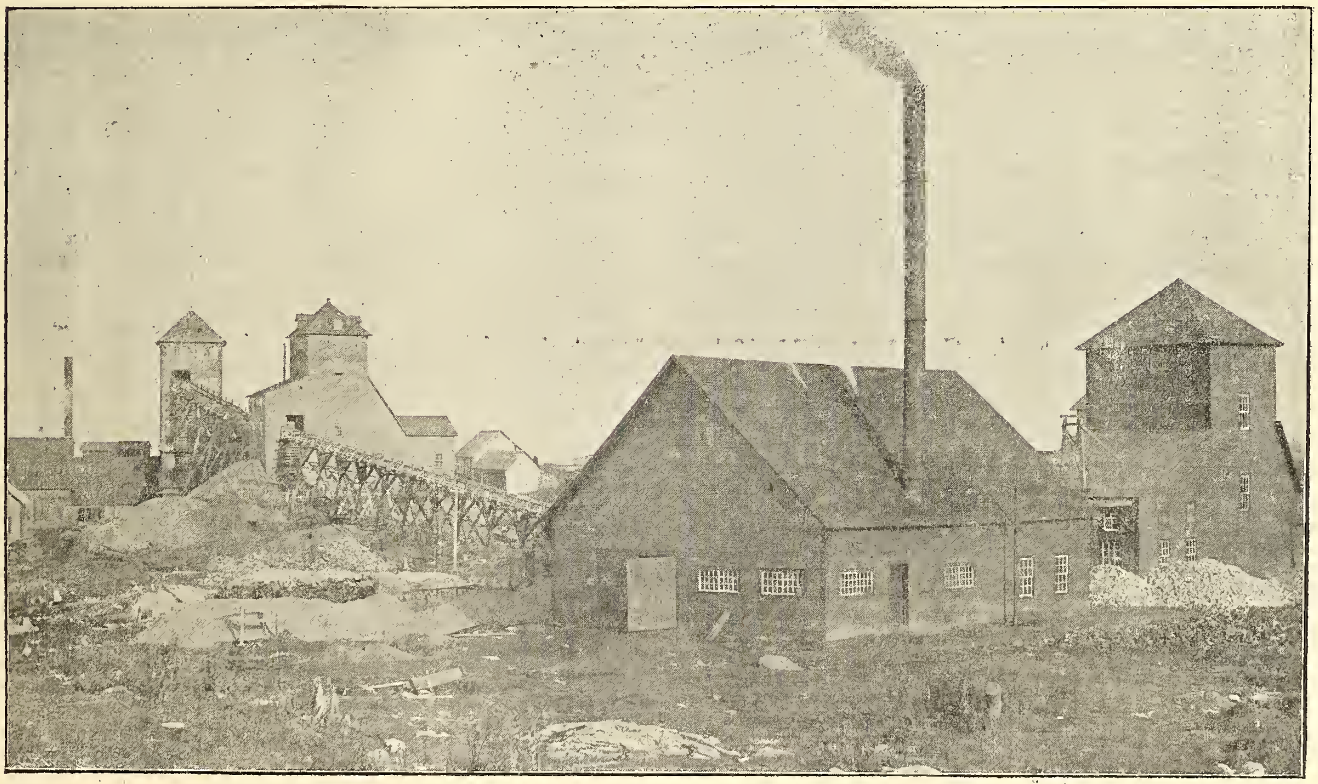
The ground being worked by the Van Winkle Company is situated on the west side of the Fraser river about two miles above Lytton. It consists of a series of terraces rising in steps from the river toward the bases of the mountains. The first of these is about 100 feet above the river, the second some 60 feet higher, while others occur at various still greater heights. The first has taken the form of a great isosceles triangle, of which the apex touches the river, the base being about 1,200 feet distant. The yield in gold has not yet been found to be so good as the rich character of the old flat worked over here many years ago appeared to indicate it would be, but the prospecting carried on in advance of the work shows richer ground.

The water employed is brought along the upper terraces by ditch from a branch of Stein Creek and then down to the work by an 18-inch pipe-line 1,500 feet long. The working head is about 350 feet and about 1,600 inches of water is employed.

The auriferous gravels at Horse-Fly are probably of Pliocene Tertiary age and are overlain by boulder-clay, referable to the glacial period. Those in the Cariboo



FRONT VIEW CAPELTON CHEMICAL AND FERTILIZER WORKS.



ALBERT MINES—Nos. I, II and III SHAFTS.

Company's pits are in part inter-glacial and in part pre-glacial, but probably all newer than the Horse-Fly gravels. The deposits near Lytton which are being worked by the Van Winkle Company are in the main still more recent, consisting chiefly of the river benches or terraces, by which the Fraser Valley is lined, and which have been formed by the gradual cutting down of the river itself after the close of the glacial period.

The geological conditions of occurrence of auriferous gravels in British Columbia, even as already known, are somewhat complicated and as work progresses great additions to our knowledge may be expected. The circumstances differ considerably from those met with in California, because of the general action of glaciation to which British Columbia has been subjected. The older gravels, where not covered by a basaltic capping, are often buried under boulder-clay, while above the boulder-clay or between two deposits of this kind, are to be found extensive masses of later gravels. The study of the facts relating to the glacial period are therefore here likely to have an important bearing on the economic problems of the gold placers and the tracing out of the old auriferous drifts.

The Albert Mines and Capelton Chemical Works.

By Mr. S. L. Spafford, Capelton.

These mines and works are situated at Capelton, Que., and owned by the Nichols Chemical Co., of New York city, successors to G. H. Nichols & Co. The ore occurs in the pre-Cambrian formation.

Veins are the filling of cracks or fissures; these cracks or fissures may either extend through the earth's crust and divide it for long distances, or they may reach down only to a limited depth or be confined to single strata, so veins are exceedingly various in extent. They may be many rods in width or they may be very thin. Strata having been faulted, so veins also may have their faults and displacements. The subterranean movements that produce joints and fractures in rocks may give origin and peculiarities to veins. Faults may divide veins not only into parts that are little displaced, but into portions that are shoved hundreds of feet above or below, which of course is very perplexing to the miner.

Fissures, that have been filled gradually without eruptive aid, are veins of infiltration, and those through the agency of igneous eruptions are contact veins. The latter is considered the most prominent in depth. There seems to be a diversity of opinion as regards the formation of the veins at Capelton and Eustis, but let that be as it may, the work done by the Nichols Chemical Co. and the Eustis Mining Co. have proven the deposits to be of enormous extent.

There are a large number of ore deposits in the Capelton district, all of which are found running in a north-east by south-west direction.

About 32 years ago prospecting was first commenced at Capelton, and soon after that mining operations were commenced on lot 2, range 9, and at shaft known as No. 5 Hartford, which is now operated by the Eustis Mining Co.

My notes concerning the mines will now refer specially to those owned and operated by the Nichols Chemical Co. Their workings consist of shafts Nos. 1, 2, 3 and 4. The present depth of No. 1 is 2,100 feet on the slope of the vein, which averages about 30 degrees from the horizontal. When the above company first commenced operations sixteen years ago, this shaft was only 300 feet deep. No. 3 shaft is about 400 feet deep and No. 4 is about 700 feet deep. The longest level in the latter is a little more than 650 feet, following a productive vein all of that distance, except for about 50 feet where a cross course disturbed the lode, forcing the vein to the left, or back into the foot that distance. The cross course causes a displacement of the vein on the horizontal, forcing it either to the right or left. It is a matter of great importance to the miner to know in which direction he will find the vein. If approaching the cross course from the west it is usually a left hand throw, but there is no rule that can be depended upon.

The method of mining is by sinking the shaft about 8 by 12 feet in advance of the other workings. Levels are then extended on the vein and the ground is blocked out by sinking winzes or raising from a lower level to one above it. In distance apart these levels are from 65 to 100 feet, thereby giving very high and long stopes.

In No. 1 shaft the deposit has a length of about 300 feet, and varies in width from 2 feet at the ends to 45 feet at the widest place. Slides have been met with in different places. These faults merely caused displacements of the vein, the most prominent being an upthrow of 20 feet. The vein is also crossed by a very large trap dyke, which does not in any way disturb or affect the vein.

The selvage being wavy causes irregularity in the width of the vein. The dip, which is to the south-east, is very irregular also. In some places it is almost perpendicular, while in others it is nearly horizontal.

Large pillars of ore are left standing in suitable places to support the roof of the mine. Usually the ground is firm, but occasionally the heavy blasting loosens bands of slatey rock which are kept in place by heavy and very large timbers.

The bottom part of the mine is very free from water. The surface water is caught in large cisterns near the surface. The pumps used were manufactured by Guild & Garrison of New York. The water being strongly charged with copper in solution, which is very destructive to iron, it is necessary to have the water end of the pumps made of bronze, and the piston, piston rod etc., made of brass. Three inch cast iron pipe is used for conducting the water to the surface.

The battery of tubular boilers at No. 1 shaft consist of seven set parallel with each other. Four of them are 80 horse power each, one 60 horse power, and two 50 horse power each, making a total of 480 horse power. For steam purposes bituminous coal is used entirely.

Two Air Compressors, one a compound Norwalk, main 20 x 24 in. cylinder, the other an English duplex 16 x 36 in. cylinders furnish the compressed air for drillling. There are three large air receivers, the largest being 6 feet by 30 feet, and the air is carried from them down the shaft in 5 inch and 4 inch pipes where it is at different points diverted in smaller pipes to the many different workings where power drills are in operation. Ingersoll-Sergeant and Rand power drills are used.

The hoisting engine is a double friction winding engine, 20 x 24 in. cylinders, 250 horse power, speed 700 feet per minute, with two drums 6 feet in diameter, each drum has a powerful spur wheel keyed on drum shaft, which meshes the driving pinion on engine shaft.

The hoisting rope used on these drums is made of the best plough steel, breaking strain 30 tons. It is 1 in. diam. has 6 strands with 19 wires in each strand and hemp centre.

Automatic dumping hoisting skips are used, which are made of heavy steel plate, and have a capacity of 3 tons.

The machinery in the concentrating plant is driven by an 18 in. x 24 in. single straight line engine, having a driving wheel 24 in. by 10 feet.

The plant also has a 400 h.p. surface condenser, the circulating water being supplied by a compound pump, having an 8 in. suction and a 6 in. discharge.

The head house is 75 feet high. The ore discharges out of the skips on to a series of bar screens, after which the very largest pieces pass through a 15 in. x 30 in. ore breaker. The ore of proper size for hand picking passes from the screens on to a travelling picking table, 4 ft. wide by 32 ft., which is driven by an 8 in. belt. A few boys stand on each side of the table and pick out the rock while the table is in motion conveying the ore and discharging it into two 6 in. x 20 in. ore breakers, and these break it down to proper size for transportation. The fines, which include all that pass through a one inch screen, is conveyed by elevator to a revolving screen, which separates the fines from the half inch and larger. The latter for further sizing down is put through the Cornish rolls which are 15 in. x 30 in., and it is then conveyed to the last revolving screen, delivering each size to their own jigs. The concentrating plant produces three sizes of ore, viz:—lumps, smalls and fines.

Shafts No. 3 and 4 are each equipped with two 75 horse power tubular boilers, and each has a 75 horse power friction drum winding engine. The two air compressors at No. 1 supply all of the compressed air required. The distance between No. 1 and No. 4 is about 1,500 feet.

The hoisting and concentrating machinery was supplied by Mr. Earl C. Bacon of New York.

The ore is transported from the mine by wire rope tramway to the stock sheds near the Boston and Main siding. The tramway in use was patented by Mr. Hodgson. Its construction consists of an endless wire rope, one inch diameter, and 9,400 feet long, running on grooved sheaves, 24 in. diameter, which are secured on the cap piece of the bents or supports. In order to make the grade as regular as possible the bents are from 15 ft. to 50 ft. high and they are 100 feet apart. At each end of the line there is an 8 ft. sheave around which the rope runs. The buckets in which the ore is carried are made of wrought iron and each holds 350 lbs. At each terminal there is a fixed rail. The box heads or saddles which carry the buckets, have two small wheels on the side, and when the bucket arrives at either end the wheels ride on the fixed rails and the bucket can be filled or dumped while the rope keeps in motion. The buckets are hung on a wrought iron hanger which is secured to the box heads. The loading end of the line is about 500 ft. higher than the discharge end. The speed is controlled by a 15 h.p. engine which is geared to the pinion or driving sheave shaft. The capacity is 200 tons in 10 hours. The coal consumed at the mine is also conveyed by this tramway.

The owners of the mines have always utilized the whole ore product, the first treatment being converting the sulphur contents into Sulphuric acid.

Brimstone was first used for sulphuric acid making but since cupreous pyrites has come into market, brimstone is to quite an extent driven out of sulphuric acid works. The sulphur in pyrites must be driven off before the copper can be obtained, consequently its sulphur will probably always be cheaper than brimstone.

Pyrites for sulphuric acid making was first used in 1818. Considerable difficulty was experienced in lighting the kilns because it was attempted from below. It was discovered by accident that lighting them from the top was the quickest way and since then that method has been used.

It is said that in 1614 the apothecaries produced sulphuric acid by burning sulphur in moist vessels with access of air. The price of acid at that time was $6.00 per pound or $12,000 per ton. In the year 1740 acid making was carried on near London and the price was reduced to 45 cents per pound.

In 1746 Dr. Roebuck of Birmingham introduced the first lead chambers. In France the first lead chambers were erected by Holker in 1766, while in Germany they were not introduced until the year 1820.

Chemical works were first constructed at Capelton in the year 1887. The works were designed by Mr. J. B. F. Herreshoff of New York City. The main buildings are 175 feet long by 75 feet wide and 3 stories high. These buildings being very wide made it necessary to use the truss roof, which is covered with slate supplied from the quarry near Richmond Que.

The kilns are constructed of fire bricks and have cast iron fronts, each burner being independent of the other. The percentage of sulphur in the ore controls to quite an extent the quantity of ore which can be burned per superficial foot of grate surface.

Usually the results are from 30 to 45 pounds per square foot in 24 hours. The ore should be used neither in too large nor in too small pieces. If the pieces are too large the sulphur would not properly burn out, and then would remain green cores in the interior of the cinders. In the other case if the pieces are too small they prevent the proper access of air.

The oxygen of the air being transferred to sulphur dioxide (SO_2) through the interposition of the acids of nitrogen and with the aid of a vapor (steam) produces sulphuric acid as a final product. The substances coming into question here, except the final product are in the state of a gas or a vapour. For reaction it takes a certain time, therefore there must be a large chamber space given so the gas can remain for some time. The gases and acids being very strong, quickly destroy wood of any kind, anb it is necessary to construct all acid chambers of lead.

The Glover Tower, which in its special structure is patented by the Nichols Chemical Co., occupies an intermediate position between the kilns and chambers. It is a rapid and economical concentrator, besides being valuable for dinitrating.

Pans are used for concentration of the sulphuric acid. The final products are oil of vitriol and extra concentrated or 98% acid. The former comes largely into use for refining oil and the latter for mixed acid making is an important factor.

To suit the requirements of the trade the product is shipped either in carboys, iron drums or tank cars. To retain its transparentness oil of vitriol must be kept free from dirt.

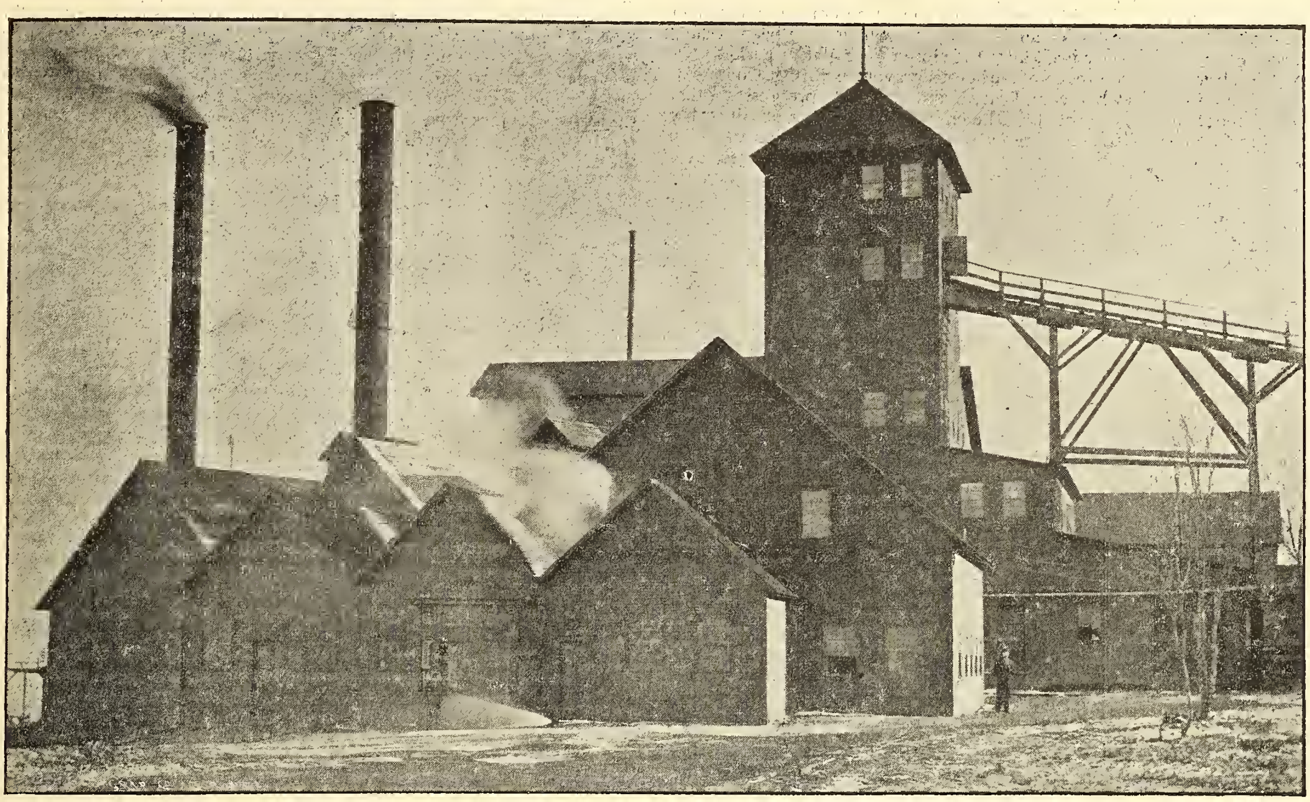
In the superphosphate industry sulphuric acid is also largely employed.

With the agriculturist, if production is to be cheap it must be rapid and plenteous. We all know the progress of unaided nature is slow, but as we are familiar with the elements essential to plant growth, the farmer may assist and hasten the natural processes. Canadian phosphate which comes from the Buckingham district is used at Capelton for manufacturing fertilizers.

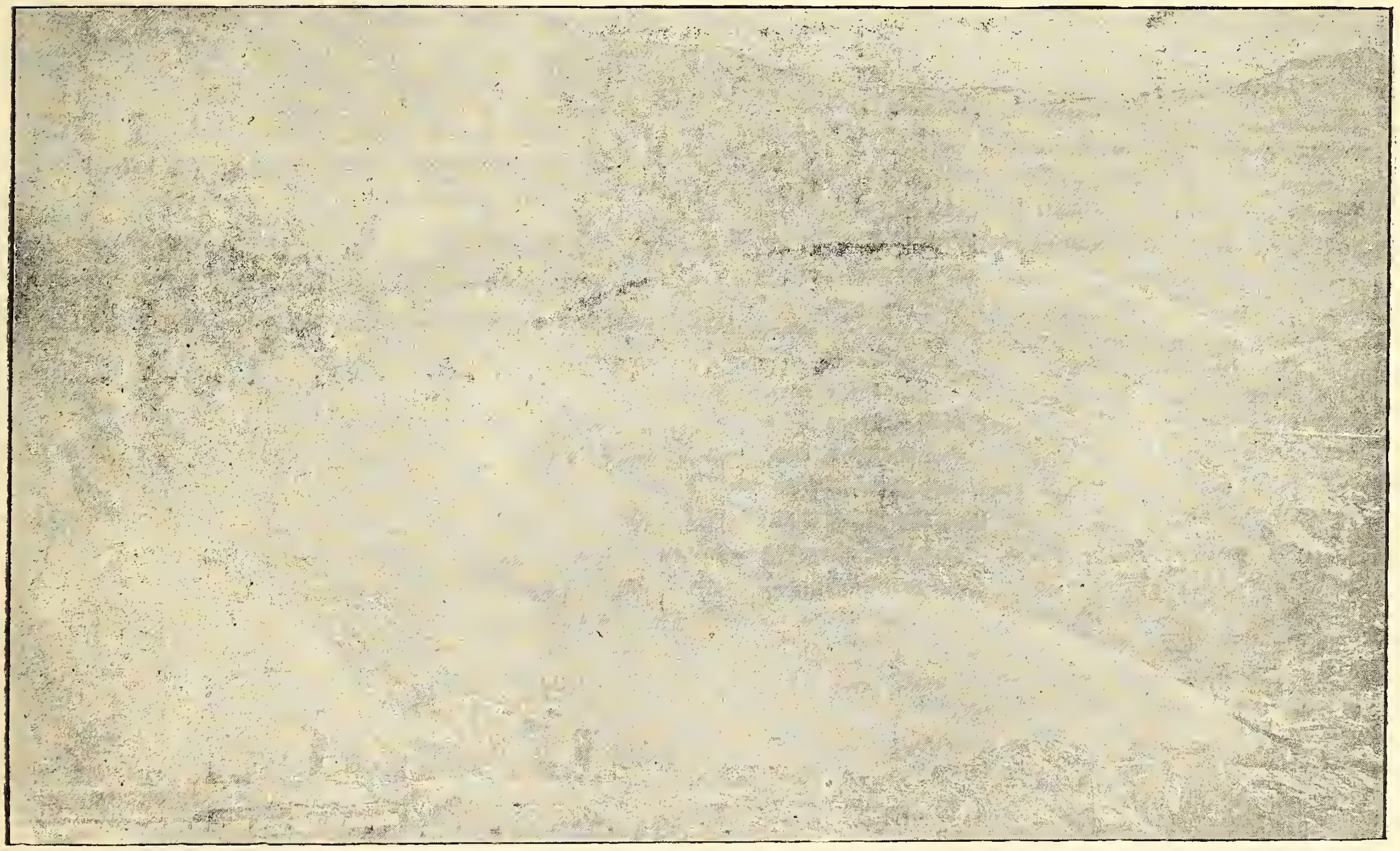
The phosphate is first dried, then ground to a fine powder in the Griffin mill. This mill employs in its construction the principle of a rigid roll, on a suspended shaft running against a ring or die. This rigid roll on a revolving shaft has freedom to swing outward against the die by the use of a universal joint. By centrifugal pressure there is great force brought to bear on the material being pulverized between the roll and die. This mill will grind about two tons per hour. After being ground the apatite is dissolved with sulphuric acid, after which ammonia and potash is added to make the complete fertilizer. It is then put through the disintegrator and then screened again.

We manufacture five different brands or grades of artificial fertilizers. The Capelton and No. 1 brand as superphosphates, and the Reliance, Victor and Royal Canadian are complete fertilizers. The goods are shipped in sacks 200 pounds each, and in conformity with the law the brand and guaranteed analyses is plainly printed on each sack.

The Herreschoff water jacket smelting furnace is used for extracting the copper in the burned cinders. The capacity of the furnace is 50 tons per day. The matte produced is shipped to Laure Hill, Newtown Creek, L.I. The buildings are lighted by electricity; the mines and the chemical works each have their own dynamo.



ALBERT MINES—FRONT VIEW No. I CONCENTRATING MILL.



GENERAL VIEW OF HYDRAULIC WORKINGS.

On the Origin of Gold Nuggets.

By A. Liversidge, M. A., F. R. S.*
(Professor of Chemistry in the University of Sydney.)

(Continued from page 252.)

"There is a tradition prevalent in all the shallow placer gold mines of the south, and in those of some other districts, to the effect that gold *grows* from the *seed* gold which is not extracted, so that every few years the tails of the old mines are reworked, generally with a profit; the quantity separated each time, according to the local tradition, being in proportion to the length of time the material has remained undisturbed." This admits of an easy explanation, although Prof. Egleston does not offer one, viz., that the gold is, of course, not wholly removed by the ordinary processes of extraction, and some, although a smaller amount, is almost certain to be obtained by each successive treatment, moreover the material becomes more broken up by the further handling and weathering, and more gold is thus set free, both mechanically and probably by chemical changes also.

He then cites, page 64, experiments of his own similar to Wilkinson's, Newbery's and many others, to show that gold is precipitated from its solution as chloride by petroleum, cork, peat, leather, leaves, &c. The petroleum threw down long crystals of gold resembling Chester's hexagonal crystals, and the peat a mamillary mass resembling the form of nuggets.

He then tried, p. 65, the solubility of gold in solutions of salts, ammonium sulphate and chloride, potassium chloride and bromide placed in sealed tubes with spongy gold for eight months gave no reaction; on heating them for five hours at 150° to 200° C only the potassium bromide gave a reaction.

Pure sponge gold was sealed up for three months with ammonium sulphide with no reaction; but both potassium and sodium sulphides gave black precipitates and a strong reaction for gold was given by the liquid in each case; the ammonium sulphide heated for six and a half hours at 145° to 180° C was unchanged but reacted strongly for gold; the solution of potassium sulphide also reacted and the glass was much attacked, further there was a black precipitate of gold; the sodium sulphide acted much more feebly. Other salts and solvents were used but with no very striking results.

He states, p. 72, that "the same conditions which cause the solution of the gold in certain cases cause also the solution of the silica." And "many of the causes which produce the precipitation of the gold would also cause the reduction of soluble sulphates to insoluble sulphides, the gold being retained within the mass. This would account for the almost constant presence of gold in pyrites."

"No single agent is so powerful a solvent of gold as chlorine. Very few drainage waters are free from some compound of it, and no soil is without the nitrogenous materials necessary to set the chlorine free, and therefore capable of attacking the gold and rendering it soluble." . . . . . The readiness of filtration through the relatively easily permeated gravel causes the gold to precipitate so rapidly that there is no time for any but a mammillary deposit, which in vein deposits the extreme slowness of the deposition allows the gold to assume the crystalline shape."

Melville Attwood, E. M., in a paper, "On the Source or Origin of Gold Found in Lodes, Veins or Deposits," (Report of the State Mineralogist of California, 1884, Vol. viii., p. 773), quotes that "M. Laur, 'On the Origin and Distribution of Gold in California,' communicated to the Academy of Sciences, Paris) mentions having found metallic gold in deposits, evidently derived from some hot springs"

M. A. Daubrèe, in his "Les aux souterrains a l'epoque actualle," (Paris, 1887, p. 33), says:—"Plusieurs geologiques (MM. J. P. Laur, A. Phillips et Egleston) ou cru reconnaitre qu' en Californie de l'or se dépose encore actuellement, particulierement dans des graviers. On prétend auussi avoir trouvé ce metal dans l'eau de Louéche et plus récement, d'apres Gotll, dans l'eau de Gieshubl et dans celle de Carlsbad."

Posepny "Zur Genesis der Metallseifen," (Œsterr. Zeits. f. Berg. und Huttenwesen, 1887, xxxv.) is of opinion that the formation of large masses of gold in the vein are more easily accounted for than in alluvial deposits.

E. Cohen, "On the Genesis of Alluvial Gold" (Jahr. f. Min., 1889, i., Ref. 439-440 from Mit. Ver. f. Neuvorpommern u. Rugen, 19, 198) is of opinion that the greater part of alluvial gold is derived by the disintegration of older deposits, but that separation from solution also occurs in a subordinate manner.

Mr. H. P. Washburn in a paper entitled "A Theory on the Formation of Gold into Specks and Nuggets" (Trans. N. Z. Inst., 1889, p. 400) opposes the hypothesis that nuggets have been formed *in situ* in alluvial deposits.

COMPOSITION OF VEIN AND ALLUVIAL GOLD.

In the preceding references there are several statements as to the greater purity of alluvial gold over vein gold, and this is by many assumed to be a proof that the nuggets and other forms of alluvial gold have had a different origin to the vein gold and that the alluvial gold has been deposited in the way suggested by Selwyn and other writers.

If we examine some of the assays of vein and alluvial gold, we shall see that there are differences but that they are not very material, and further, the vein gold is sometimes richer than the drift gold.

Selwyn and Ulrich (P. P. G. and Min. of Vict., 1866), p. 42, refer to the greater richness of alluvial gold.

D. C. Davis, F. G. S., "Metalliferous Minerals and Mining" (London, 1880, p. 50), in speaking of "the gold bearing drift of the Sierra Navada says, the particles of gold are found of larger size and contain more silver at the bottom than at the top of the ancient drift, and are worth less by two shillings and sixpence per ounce. It is supposed that their difference in quality is caused by the larger size of the fragments below resisting more effectually the action of sulphuric acid which, set free by the decomposition of pyrites, has eaten the silver out of the smaller grains at the top of the deposit.

He also says, p. 36, gold is most plentiful in it (drift in the Urals) where the drift is most largely charged with iron;" and Brough Smyth, in a Report of the "Gold Mines of the S. E. Portion of the Waynaad, &c.," (London, 1880), states that "the gold obtained in the Waynaad, is unequal in fineness, that from the soils being of the best quality. It has been observed in other countries that the finer the particles of the gold procured from alluvial deposits the higher is the quality."

P. Nisser, "On the Geol. Distribution of Gold with Special Reference to some Auriferous Rocks in South America," (Trans. Phil. Institute, Vict., iv., 1860, read 30th March, 1859) points out (p. 17) that in the Province of Antioquia, North Grenada, the gold from the vein stones differs very greatly from the alluvial gold: the former averaging 14½ carats fine, and the latter eighteen to twenty-two carats. He states that W. Birkmyre found that vein gold from Clunes, Victoria, was poorer than the alluvial gold, and that the same thing was observed by other assayers; and he finally concludes that since the South American alluvial gold differs so much from the vein gold that it must have had a different origin.

Bernard Von Cotta, in his treatise, "On Ore Deposits," New York, 1870, in speaking of the placer deposits of the Urals, says that the gold is generally more or less argentiferous, the amount of silver varying according to G. Rose's examinations between ·16 and 38·74%. It has been sometimes thought that the placer gold was purer (less argentiferous) than that extracted from deposits *in situ*, but G. Rose has shown that such is not the case in the Ural Mountains. He found that the amount of silver was very variable in both cases, although the highest amount of silver was found in gold from veins, which contained even in the same lode very variable quantities."

Mr. Geo. Foord, F. C. S., of Melbourne, could find no difference between the quality of the internal and external portions of nuggets; but in one case he found a vein which was of a greenish-yellow in the centre, from the larger amount of silver present in that part of the gold.—Brough Smyth, "Gold Fields and Mineral Statistics of Victoria," p. 359-60.

Mr. Birkyre, p. 371 of the same work, points out that the "Welcome" nugget weighing one hundred and eighty-four pounds, nine ounces, gave him 23 car. 3⅝ grs. gold or 99·20%, or it was nearly as rich as the finest gold dust, viz., 23 car., 3⅝ grs.

The following analyses of gold from the North Transvaal, (E. Cohen, Jahr. f. Min., 1889) show a slight difference between the vein and the alluvial gold; but much importance cannot be attached to it:—

	Residue.	Ag.	Au.	Cu.	Fe.	Total.
1. Vein gold.	.02	5.16	94.48	.25	trace	99.91
2. Alluvial gold.......	.78	6.49	91.38	.09	"	98.74
3. "	.07	5.64	95.16	.	"	99.87
4. "	.07	4.57	94.87	.11	"	99.62

1. Vein gold, Button's Reef, Marabastad, North Transvaal.
2. Alluvial gold, Button's Creek, derived from above.
3. and 4, Alluvial gold, in flakes and grains.

EXPERIMENTS.

Freshly fractured pieces of the following sulphides were placed in cylinders of the photographer's gold toning solution (fifteen grains of the double clhoride of gold and sodium in fifteen ounces of water) viz: iron pyrites, molybdenite, mispickel, galena, copper pyrites, blende, argentite, &c.

In some cases the sulphide reduced the gold at once and became gilt or coated with the reduced gold, either as a bright coherent deposit or else as a dull ochre-colored one. Successive quantities of the gold solution were added from day to day as it became colorless, and in this way quite thick and strong deposits of gold were formed on the sulphides.

In the case of the molybdenite, MoS_2, the gold deposit was at first lustrous and metallic, but as time went on it became of a dead brown aspect, although this under the microscope was seen to be made up of brilliant metallic points of light. Blue and white oxides of molybdenum separated out.

The deposit on the mispickel was not compact and coherent like that on the molybdenite, galena, and other minerals, but loose and easily rubbed off.

The deposit on the iron pyrites was also bright and metallic looking at first but as it thickened it became dull and ochre-like in color.

The deposit on the galena was similar to the above; under the microscope, the surface, as in other cases, is seen to be minutely mammillated, and it is on that account that to the unassisted eye, the gold has a dull brown or ochre color.

The preceding experiments are not unmbered because they are merely qualitative ones, but the next series of experiments were quantitative; weighed pieces of pure sheet gold were put up with various organic reducing substances; sulphides and other naturally occurring substances which I thought might form a galvanic couple, and which would throw down the gold from solution upon the plate as in the electroplating process.

A.—WITH A GOLD NUCLEUS AND ORGANIC MATTER.

In the following experiments, pure gold specially prepared by the late Dr. Liebius, senior assayer of the Sydney Mint, and assaying 1000 was rolled out into fillets of $\frac{1}{200}$ inch thick, so as to expose a large surface and yet be strong enough to handle, these were heated in a cornet crucible to burn off impurities and then boiled with nitric acid, and well washed to get rid of any sulphur of other contaminations from the gas flame. The nuggets and specimens of native gold used as nuclei were also cleaned in the same way. The fillets were next weighed and placed in stoppered glass cylinders with a solution of the sodium chloraurate, supplied for photographic purposes, and made up of the usual strength of a fifteen grain tube of the salt to fifteen ounces of water.

The reducing substances were similar to those used by Wilkinson, but as will be seen with results just the reverse of what he obtained, *i.e.* the gold foil or other nucleus weighed less instead of more after the experiments.

Experiment 1.—A water worn nugget was used as a nucleus the dust of the air was allowed to fall in, and the experiment was continued for one hundred and sixty-eight days, with an occasional addition of gold solution as the liquid in the cylinder became colorless from the reduction of the gold. Although a good deal of gold was precipitated on and around the nugget none of it was adherent, and on re-weighing it was found to have lost 002 gramme.

Experiments 2 and 3.—A plate of pure gold was used as a nucleus in each case, and the solution was exposed to the air as above; one plate lost ·0042, and the other ·0038 gramme.

Experiment 4, with cork.—The gold solution was left in a stoppered cylinder with a slice of clean, new cork, until the yellow color of the solution had disappeared, showing that all the gold had been removed from it. Some gold was precipitated at the bottom of the cylinder, some on the sides, and a little floated as films on the top, there was also a small quantity of gold precipitated on the gold plate, but this was non adherent and came away on washing the plate in a jet of water. This plate underwent no change in weight.

Note.—All of my experiments were carried out in full daylight, and not in the dark like those by Wilkinson, Egleston and others.

Experiment 5, with Swedish filter paper.—The yellow colour soon disappeared from the solution, and the paper acquired a purple colour. The gold plate lost ·0036 gramme in weight.

Experiment 6, with phosphorus in ether.—The solution soon became colorless, and a black precipitate of gold was thrown down on the bottom of the cylinder and on the gold plate. Floating films of gold also formed on the surface. On washing the gold plate with a jet of water all the gold deposited on it was washed away, and on drying and weighing it was found to have lost ·0004 gramme.

Experiment 7.—In this case a freshly broken jagged fragment of gold in quartz was used as the nucleus instead of a gold plate, but cleaned with the same care. Cuttings from a cedar pencil and some scraps of paper were added, these acted in the same way as the cork and were "mineralized" by the reduced gold; the gold and quartz nucleus lost ·0021 grammes in weight.

Experiment 8.—Paper and wood were used as in experiment 7, with a nucleus of jagged gold set free from quartz by means of hydrofluoric acid; the nucleus lost ·0013 gramme.

Experiment 9.—Similar to experiment 8 with a necleus of native gold from Sandhurst (Bendigo). This showed a loss of ·0001 gramme.

On incinerating the cork, ceder, &c., which had been used for reducing the gold, the residùe retained the original form, but much shrunken and as has been observed by others, the microscopic structure of a cut section presents the appearance of burnished gold from the pressure of the knife.

No.	Nucleus.	Reducing matter.	Original weight of nucleus.	Weight of nucleus after experiment.	Difference in gms.	Number of days.
1.	Nugget	Dust from air.....	3.4920	3.4900	.0020	168
2.	Gold foil...	" " "	1.5152	1.5110	.0042	168
3.	"	" " "	1.1713	1.1675	.0038	168
4.	"	with cork	1.1410	1.1410	None	273
5.	"	with filter paper. .	8500	8464	.0036	273
6.	"	Phosphorus in ether	9330	9326	.0004	273
7.	Gold in quartz. . .	paper and wood...	1.7630	1.7609	.0021	58
8.	Gold from "	" " " ...	2.8487	2.8474	.0013	58
9.	" " "	" " " ...	6574	6573	.0001	58

The above experiments all show that instead of the nucleus or nugget of gold increasing in weight and size in the presence of organic matter, there is a decrease which is just the reverse of the effects obtained by Wilkinson, Daintree, and others.

The loss in weight of the nucleus may have been due to the removal of small quantities of impurity in the gold used as a nucleus, the native gold would of course contain silver and other impurities, but the gold foil was regarded as particularly pure by the late Dr. Leibius of the Sydney Mint, by whom it had been assayed. This will be the subject of further experiment, the point of chief interest at this stage is that the nuclei did not show any increase in weight.

(To be continued.)

ONTARIO MINING INSTITUTE.

Proceedings of the Kingston Meeting on 3rd and 4th January—A Large Addition to the Membership—Many Papers of Interest Discussed.

The second ordinary meeting of the Ontario Mining Institute opened in Carruther's Hall, on Thursday morning, 3rd January, Dr. W. L Goodwin, Vice-President, in the chair.

THE SECRETARY read the minutes of previous meeting, which were confirmed; also a letter from the President, Mr. James Conmee, M.P.P., regretting inability to be present.

Federation.

THE SECRETARY submitted the Report of the Mining Society of Nova Scotia on a scheme for the federation of existing Canadian Mining Associations.

MR. HAMILTON MERRITT also presented the report of the Committee of the Institute which had been forwarded to the Quebec and Nova Scotia Societies.

After considerable discussion the Report of the Mining Society of Nova Scotia was in the main approved, but the clause anent subscriptions was referred to a sub-committee comprising Prof. Goodwin, Prof. Nichol, Mr. A. Blue, Director of Mines, and the Secretary, to report at a later stage of the proceedings. This committee after due consideration recommended the following amendments to the consideration of the Quebec and Nova Scotia Societies:—" That each of the Societies in the Federation shall pay the expenses of printing and illustrating its own portion of the Proceedings of the Institute, the rate per page not to exceed one dollar and a half." (Or as an alternative.) " The Societies in the Federation shall each pay an annual subscription towards the expenses of the Institute of such an amount as may be determined upon at each annual meeting, but the contribution from each society shall at no time exceed in amount the sum of three dollars per capita."

Meetings and Student Membership.

THE SECRETARY tabled a notice of motion to amend the Constitution and By-laws so that two meetings of the Institute should be held in each year, instead of three as at present; also, so as to create a student membership at a nominal fee.

Legislation re Mining Engineers.

MR. HAMILTON MERRITT moved the appointment of a committee comprising Prof. Goodwin, Dr. Coleman and Mr. Merritt, to report upon the advisability and feasibility of legislation for the registration in the Province of duly qualified mining engineers. It was highly desirable, he thought, that where such educational institutions existed in Ontario as the School of Mining and the School of Practical Science, something should be done to prevent or to minimize the practice of quacks in the profession. It seemed to be the rule in Ontario that where people were engaged in an occupation in which life and limb were endangered they should be required to conform to a certain standard of qualification. The matter had been under consideration and had been discussed in Nova Scotia. Personally he thought that mining engineers had as much right to protection as doctors, dentists and lawyers.

MR. B. T. A. BELL thought that the motion might be tabled for discussion as to ways and means at a future meeting. While in sympathy with the principle involved he could not see how legislation would improve matters. He could mention cases in which the biggest frauds had been perpetrated by mining experts who had all the letters in the alphabet behind their names. Some of the ablest and most competent mine managers were men who had never seen a school of mines or taken a degree. A science course would never compensate for the absence of honesty or common sense.

PROF. NICHOL having seconded Mr. Merritt's motion, it was put to the meeting and carried.

New Members.

The following were elected to membership:—

Mr. John Donnolly, Kingston.
Mr. B. H. Klock, Klock's Mills.
Mr. W. G. Kidd, Kingston.
Mr. Wm. Mason, Kingston.
Prof. Dupuis, Kingston.
Mr. Fred. Burroughs, Napanee.
Prof. Carr Harris, Kingston.
Mr. Bruce Carruthers, Kingston.
Mr. T. L. Walker, Kingston.
Mr. J. Newlands, Kingston.
Mr. E. Musgrove, Kingston.

The morning session then adjourned.

AFTERNOON SESSION.

The members re-assembled at three o'clock, Mr. W. Hamilton Merritt in the chair. Dr. Goodwin opened with an excellent address on " Nature's Concentration of Minerals," which we hope to reproduce in a future issue, together with the discussion that followed.

Diabase Dykes in the Sudbury Region.

MR. T. L. WALKER, M.A.

During the past few years the rocks of this region have received considerable attention. At the time of the construction of the Canadian Pacific Railway in 1884, Professor Bonney (1) of London visited the district and made a careful microscopic study of the rocks found near the railway lines. His attention was directed chiefly to the metamorphic rocks of the Huronian belt. In 1890 the late Professor G. H. Williams was entrusted by the Canadian Geological Survey with the microscopic study (2) of a collection of Sudbury rocks. This collection had reference principally to the rocks associated with the copper-nickel ores. Baron Von Foullon (3) of Vienna spent a few weeks during 1890 studying these rocks in the field, especially with a view to ascertaining the relative ages of the different rocks.

The so called Sudbury region is composed of a belt of Huronian rocks striking north-east and south-west. The rocks to the south-east and north-west of this belt are chiefly granites and gneisses. The Huronian belt is here made up of hornblende schists, quartzites and slates, while associated with these and possibly of later age are areas of granite and greenstone. Theselatter rocks generally occur in lenticular areas whose longer axes agree with the strike of the Huronian rocks. The rocks to be considered here are the youngest in the district, and are found generally in dykes of diabase, which frequently have a strike nearly at right angles to the members of the Huronian belt.

One of the best representatives of this dyke series may be seen crossing the railway track several times between Sudbury and Murry mines. Its course can be easily followed for about three miles. The most eastern exposure is a little more than a mile from Sudbury where it cuts through feldspathic quartzites which are regarded as characteristic Huronian rocks. About a mile farther along the journey to Murray mines, just near a pit from which clay has been taken for furnace purposes, another good exposure occurs, but at this point the rocks intersected by the dyke are the greenstones with which the nickel ores of the district are commonly associated. A curve in the railway leaves the dyke on the north side, but it may be well seen again, at the village of Murray mines, just where the colonisation road, after passing east through the village, turns south-eastward to Sudbury. In this instance the rocks intersected are granites which Bell regands as of Laurention age, but which instead can be shewn to be younger than even the nickel-bearing greenstones which he regards as not older than Huronian. This dyke is again exposed just west of the smelter at Murray mines. Here the dyke cuts through the greenstone area with which the Murray mines deposit is connected. All the exposures of diabase along the Canadian Pacific Railway between Sudbury and Murray mines, are portikns of the same dyke. Thus in following up this dyke for a distance of three miles it is seen to be of later age than any of the other rocks of the district. A second diabase dyke crosses the Canadian Pacific Railway one mile east of Worthington station. Its general direction is north-west. A third dyke crosses the railway about one quarter of a mile east of Worthington station and shews about the same general direction as the others. Many other examples occur, some of which are said to have other directions, but all those examined by the writer, have a general north-westerly direction. In width they vary from a few feet to fifty yards.

One thing characteristic of these dykes is the ease with which they are acted upon by hydro-chemical agencies. Near the Village of Murray Mines, the Government road passes for some distance between high walls of granite, which have become prominent by the weathering out of the diabase. The nickel bearing greenstones resist the action of atmospheric influences much better, and are generally greenish on weathered surfaces. In this they stand in contrast to the rocks under discussion, which become quite rusty on exposure. Spheroidal weathering is characteristic. When well exposed the diabase seems to be made up of ball-like masses, varying in size from a few inches to several feet in diameter. Decomposition is seen in the separation of concentric layers. Good exposures of this weathered rock often resemble walls built of cobble stones. With a view to understanding the reason for this concentric weathering, a thin section was made of a ball about three inches in diameter. No radial or tangential arrangement of any of the constituent minerals could be noticed. Mineralogically the centre of the ball did not differ from the portions nearer the surface. If these ball-like forms originated from the molten magma by crystallization beginning at independent centres, which afterwards became the centres of the balls, then we would expect the central portions to contain the more basic minerals. The microscopic examination of the large section did not confirm this anticipation. This structure has been regarded as due to contraction on cooling after solidification. Spheroidal weathering is very frequent in diabase. One of the exposures on the Canadian Pacific Railway, just east of Worthington station, shews phenocrysts of plagioclase from one to two inches long. This porphyritic phase is confined to a margin of from four to six feet along the wall. The rocks intersected show contact action, since, for three yards from the junction with the diabase the states are broken into rhombohedral fragments. Just behind McGregor's house at Murray Mines a similar action is shewn. The granite, along the contact with the diahase, is shattered into layers parallel to the contact. Adjoining the diabase these layers are about one-third of an inch wide; the width of the successive layers gradually increases till a maximum of two and a half inches is reached at about two feet from the contact. A section from one of these layers of granite, shewed, under the microscope, that considerable limonite had been developed, and that the feldspar was somewhat kaolinised. Besides, the quartz grains appear to have been shattered by the heat;

(1) Quart. Jour. Geol. Soc., vol. 44, p. 32.
(2) Geol. Survey Canada. Report of Progress 1891, F, p. 59.
(3) Jahrb. d. k. k. geol. Reichsanstalt 1392, p. 276.

they are seen in groups having nearly the same orientation as though larger grains had been broken up into several fragments which now form one of the groups of grains with nearly simultaneous extinction. No glassy borders were observed on the diabase, but this may be due to the ease with which the rock decays. In one instance a dyke was examined which shewed a trench ten inches wide and about twice as deep, along the line of contact. This was probably caused by the comparatively rapid decay of a glassy border, but there was no opportunity of obtaining fresh specimens of the dyke quite close to the contact. Near the border the rock is fine grained, but within a few inches it becomes almost as coarse as at the centre of the dyke.

Mineralogically considered, the plagioclose is the most abundant. It is generally quite fresh, but at times somewhat kaolinized. Idiomorphic much twinned crystals are characteristics. From a measurement of the angles of extinction in thin sections it appears to be one of the most basic members, such as labradorite. The relative proportions of lime and soda found in the general analysis of the rock point to its being a feldspar containing very much more lime than soda, such as we have in the case of labradorite. Wandering extinction and zonal structure are very frequently observed. In some of the slides prepared from the dykes near Worthington the feldspar crystals in a few cases contain slender inclusions, probably of glass, arranged with their longer directio i parallel to the contact between the successive twinning lamellae. The twinning is commonly according to the albite law, but a combination of the albite and pericline laws is not infrequent. In one section from the dyke near Murray mines, twinning was seen combining the albite, pericline and baveno laws. Being the earliest of the silicates to crystallize, we have the ophitic structure beautifully developed by the idiomorphic lath-shaped forms of the plagioclose. The quantity of pyroxene varies. In the exposures near Murray mines about one-quarter of the rock is pyroxene, while at other points on the same dyke and also in the dykes near Worthington the pyroxene does not form more than one-eighth. It is noted that where there is most pyroxene there is least olivine and *vice-versa*. The total quantity of olivine and pyroxene is nearly constant—the one increasing as the other decreases. The olivine occurs in pale greenish yellow grains which are generally somewhat rounded, and are a little younger than the feldspar, but older than the pyroxene. In a few cases the olivine has given rise to serpentine and fine grains of magnetic iron ore. The pyroxene shows no definite outline. Cleavage can be very seldom observed. It is reddish brown to violet in color and faintly pleochroic. In none of the large number of sections examined could alteration of the pyroxene be seen. The iron ores are in part magnetite and the rest is probably ilmenite. They occur in irregular grains, showing no alterative products, and are generally associated with the olivine. Very slender apatite needles are abundant and intersect all the other minerals. A few scales of strongly pleochroic brown mica, a little cloritic substance, an occosional minute speck of a brassy sulphide and a few particles of quartz complete the list of minerals. Considering the general freshness of the rock it is easiest to regard the quartz as primary.

A careful chemical analysis was made of specimens from an exposure of the dyke on the Canadian Pacific Railway near Murray Mines. The result of this analysis is shown in Column I. Column II. shows an analysis by Mr. W. F. Hildebrand (4) of an olivine gabbro from Pigeon Point, Minnesota. III. is Teall's (5) analysis of diabase from Cauldron Snout, Durham, England.

(To be continued.)

Mining Society of Nova Scotia.

Discussion on Coal Cutting Machinery—*Continued.*

MR. W. BLAKEMORE—In reply to Mr. Dick, I might say that the Messrs. Stanley of Neweaton have in their catalogue a cut of a double header, for driving levels up to 12 feet wide, and also a machine for cutting through the ribs for ventilation. In driving levels with Stanley headers it will always be a question of speed, and of necessity, often regardless of cost, and in my former paper I simply stated what the man on the machine had per foot.

At Caledonia Colliery we had a band of hard splint running from 1 to 1½ inches, situated 22 inches from the pavement, which was cut through without any perceptible difference in the working of the machine; and in several instances we got both up in the roof stone and into the pavement, and it was simply a question of having enough cutters for any ordinary stone, which would come in anything like regular layers, but I understand and would think that ironstone balls would give the cutters a hard blow, and that they would be liable to break or jump out of the wings.

The question of water makes little difference to the working of the machine, in fact having the level wet would be of considerable advantage, as it absorbs the dust which is made in cutting the circle, and which otherwise causes considerable trouble to the men in breathing.

In regard to the question of any coal cutting machine after the pattern of the Ingersoll and Harrison machines, I am very much in favor of the percussion type in room and pillar workings.

The following will, I think, answer Mr. Dick's question as to the relative time in shifting the two types of machines named. The only Jeffrey machine which did any work in Cape Breton was at the Gardener mine, and among some data of work performed by this machine I find that it required from four to ten minutes in shifting from cut to cut. This seems reasonable when you consider that the Jeffrey machine weighs 3,050 lbs., and is on runners similar to a sleigh and has to be pinched with a crowbar from cut to cut; while the Ingersoll and Harrison machines are mounted on wheels and can be easily handled, so that practically the time moving from cut to cut does not count.

In reference to my statement that any man of ordinary intelligence can work the Ingersoll or Harrison machine, I am giving a short account of our starting coal cutting machines at the Sterling Colliery, and I most certainly join issue with Mr. Dick's authority as to the percentage of men standing the shock of the percussion machines. This was a matter to which I gave considerable attention during the summer of '93 at Caledonia Colliery, and in no instance do I remember of any of our men giving up a machine on this account, or that any of our men lost weight by working the machines.

During the summer, Dr. Black, of Halifax, visited Caledonia Colliery and was very anxious to see the machines at work. During his inspection I brought this theory to his notice, and he made particular enquiry into this from the men themselves, and in every case was assured that they had suffered no ill effects from this cause.

For the consideration of your readers who may be interested in increased outputs, I am giving the following account of machine work at the Sterling Colliery:—

We commenced machine work at the Sterling pit on the 13th of August, and the first week got 530 tons, second week 644 tons, third week (in Sept.) 1,269 tons, and in 17 days of October we cut 3,622 tons from our machines.

I also give the quantity of coal cut by one of our machine men:—Aug. 16 to 31, 339 tons; Sept. 1 to 15, 316 tons=655 tons for one month; and this man had never operated a machine until the date mentioned.

(4) W. S. Bayley—Bull. 109, W, S. Geol. Sur.
(5) Zirkel—Lehrb d. Petrographie. Vol. II., page 638.

Nova Scotia Gold Output, 1894.

The following official returns have been received since our statement of November:

Name of Owner.	District.	Months.	Quartz Crushed. Tons.	Yield of Gold. Oz.	Dwts.	Grs.
W. A. Sanders	Cariboo	Aug. & Sept.	316	184.	17.	0
Mooseland Gold Mining Co.	Tangier	Aug. & Sept.	84	21.	14.	0
Antigonish Gold Mining Co.	Stormont	May to Sept.	2,435	584.	2.	0
Country Hr. Gold Mining Co.	"	Jan. to Sept.	2,424	841.	4.	1

CORRESPONDENCE.

Rapid Tunnel Work.

Sir:—In the November number of the REVIEW you cited "Rapid Tunne' Work", done by the East River Gas Co., New York. The conditons were the following:

Rock.	Heading.	Drills.	Best day shift work.	Total week's work.
Hard Hornblende. Gneiss.	10½ x 8½ ft.	Four 3½"	48½ feet.	101 feet. =9014 cub. feet.

This is undoubtedly very rapid work, but let us compare it with another one executed by the Mine Engineering Firm, Rud. Meyer in Muhlheim a/R Germany, for the "First Transilvania Gold Mining Co." in Boicza Trans.

Drills used were four 3⅜ inch Meyers air drills mounted on *one* Meyers Universal two column drill carriage.

Rock.	Heading.	Length of Tunnel.	Time used.	Best month's work.
Solid tough. Trachyte and amygdaloid.	10.17 x 9.18 ft.	6,575 feet.	524 days.	449.6 feet.

Average per week: 101.5 feet=9476 cubic feet, or 5.18 feet of 10½ x 8½ feet of tunnel in favor of the latter work. I do not know what the best day's work was but the above figures compare very favorably with the East River Co's work, if it does not show quicker work, especially if we consider the very stringent mining laws in Germany and Austria in regard to underground works, also the carrying along of a water trench 19.6 x 19.6 inches. 55,000 lbs. of dynamite were used, and no accident occurred.

Since the finishing of this tunnel two years ago the firm has driven several other long drifts with its still further improved air drill and compressor, and has beaten the above mentioned work, but these can not be compared here so well side by side with the East River Gas Co's work, as the drifts were smaller. The German mining laws do not permit the blasting down of the whole face of the tunnel, or drift breast, nor the drilling of such deep holes as used in this country for this kind of work, which tends to a considerable saving of time and a greater efficiency of the blasts, besides the narrower space of the drifts or levels does not permit the crew to move as easily about in carrying off the loose rock.

F. HILLE, M. E. and Ch.

PORT ARTHUR, 2nd Jan. 1895.

Complimentary.

Sir:—Although not enjoying a personal acquaintance with you, but being a member with you of the Mining Society of Nova Scotia, I cannot refrain from expressing to you herewith the great satisfaction it is to me, and I think to all members of our worthy Society, to feel and to know that our official expounder, the CANADIAN MINING REVIEW, is ever ready and alert to place before the reading public a truthful statement of facts and solid intelligent information regarding projects liable to mislead any one who may be or is likely to become interested in the mining industry of the Dominion of Canada, especially the Lower Provinces, which are of so great importance to all of us.

The fact of so much misrepresentation in the past by speculative individuals and irresponsible companies is one of the greatest drawbacks to-day from the progress and development of our mining industry.

My expressions herein stated were drawn forth, particularly at this time, by reading the leading article in the December issue of "THE MINING REVIEW" and the company's prospectus to which it refers.

Personally my interests are with gold mining but truth is unchangeable with all matters.

Yours, etc.,

BOSTON, 4th Jan., 1895. C. FRED. HOWE.

COMPANIES.

Ontario Peat Fuel Co., Ltd.—The annual general meeting of shareholders of this company is called for 30th January, but as the directors are desirous of submitting plans and specifications of the proposed changes to be made in buildings, machinery, etc., for the production of moss-litter, it is likely an adjournment will be made until 21st February.

Tulameen Mining Co.—This is a new company with an authorized capital of $30,000, formed to operate hydraulic mining in British Columbia. The promoters are Wm. Hogg, Vancouver, W. B. Stephens, Montreal, A. Fleck, C. Berkley Powell and W. Harris, C. E., Ottawa.

Bellingham Bay Hydraulic Mining Co.—Formed under the Foreign Companies Act, B. C., with head office at Fairhaven, Whatcom Co., Wash., to conduct mining operations in British Columbia.

Slocan Surprise Co., Ltd.—Registered 27th December, 1894, under the Foreign Companies Act, B. C., with an authorized capital of $225,000, and head quarters in Chicago; to mine and smelt ores in the Province of British Columbia.

Hall Mines, Ltd.—The second annual meeting of shareholders of this company was held at the offices of the company in London, E.C., on 19th ulto. We quote the following from the report to the shareholders, "As soon as the purchase of the property was completed the first matter the Board took into consideration was the advisability of sending an expert out to the mines to report upon the whole property and to advise the Board as to the best method of opening up and working the same." Accordingly Mr. Charles Harvey, the company's consulting engineer examined the mine in September and on his report the directors decided to adopt a policy of simply prospecting before going to any great expense for machinery and laying down of tramway. Mr. J. J. Jordan was appointed mine manager. The following machinery was put in:—Portable engine and boiler, compressor, diamond drill, crusher, sorting table and "in view of the necessity of a tramway from the mine to the proposed site for concentrating works, the directors introduced a bill into the Provincial House of Assembly at Victoria for the necessary powers to expropriate land for this purpose, and this bill has been passed. Your chairman inspected the company's property during his recent visit to British Columbia has reported that the favorable impressions previously formed by him from what he had heard and read about this mine were fully confirmed by his own observations which have convinced him that the Hall mines enterprise is a thoroughly *bona fide* undertaking and gives encouraging prospects of profitable results." The expenditure at the mine was £11,971 3s.4d; and in London, £4,223 5s.5d.; the total outlay for the year amounting to £25,456 14s. 11d. On the other side of the balance sheet we find:—Ore sales realized £5,360 14s. 2d.; value of ore on dump at formation of company still unrealized, £7,345 16s.; tools and stores in hand, £1,337 18s. etc., leaving a balance in excess of expenditure over income to date, against which there is a stock of ore in dump at the mines awaiting treatment £11,402 0s. 9d.

General Mining Association, Ltd.—We are officially advised that the coal disposals of this company for the year 1894 were: 211,000 tons *round*; 12,000 tons; or a total sale of 223,000 tons.

Thompson River Hydraulic Mining Co., Ltd.—During the year this company acquired their leases on Tranquille river, about 12 miles from Kamloops; built a dam, flume and ditches, and put in a plant capable of moving 2,000 yards per day. Owing to early frost only a partial clean up was obtained, but the company succeeded in proving a portion of their ground, being 40 feet above the water level, which gave about 50 cents per yard. Work will be resumed in March.

The Lillooet (Cariboo) Gold Mine, Ltd., has been registered with a capital of £40,000 in shares of £1. Directors: F. S. Barnard, M.P., Victoria, B.C.; A. E. McPhillips, Victoria; C. T. Dunbar, Lillooet, B.C.; Reginald Northall Lawrie, London, Eng.; Robert Horne-Payne, London, Eng. Head office: 54 Old Broad street, London, E.C. Has been formed to acquire and develop gold claims in British Columbia, and in particular certain hydraulic claims at and about the village of Lillooet, Fraser river, and known as the Irving, Jensen and Macdonald & Hurley, Robson and Welton claims. The lands are held under Provincial Government leases and comprise altogether about 480 acres The Macdonald & Hurley claim has been worked since 1890, and with only 200 miner's inches of water, very limited means, and primitive methods of development, such results as the following being obtained: "Mr. A. W. Smith, M.P.P., certifies that he bought gold from the claim as follows:—From 1890 to 1892, value $4,179; in 1893, value $1,500. Mr. C. A. Phair, (Government Mining Recorder), certifies that he bought gold from the claim between 1890 and 1893, value $725. Mr. A. Macdonald certifies that he sold gold from the claims in 1893 in Montreal and Ottawa, value $1,200. Mr. Angus Beaton, who managed the work on the adjoining claim, certifies that with six months' work and 200 miner's inches of water, it yielded $6,700 in 1893. The other claims have been worked by Chinamen, who claim to have averaged $4 to $5 per day, but no absolute record of these results is obtainable. A thorough examination and careful prospecting of the claims are recommended before shareholders are committed to a heavy outlay upon works.

The Golden Lode Mining Co., Ltd.—The officers of this Nova Scotia Gold Company are: H. H. Bell, *President*: A. M. Jack, *Sec.-Treas.*; F. S. Andrews, J. T. Burgess and A. A. Hayward, *Managing Director*.

New Glasgow Iron, Coal and Ry. Co., Ltd.—Official returns furnished the REVIEW show the furnace record for the year ended 31st December to have been:—Total pig iron made, 28,142$\frac{1}{2}\frac{8}{0}\frac{8}{0}$ tons of a value at furnace of $295,500.90; ore charged, 60,817 tons of a value of $121,634; fuel charged, 42,378 tons of a value of $104,516: flux charged, 22,928 tons of a value of $22,928. 450 persons employed.

Cariboo Hydraulic Mining Co., Ltd.—At this company's property on the South Fork of the Quesnelle river, B.C., eight miles of ditch have been constructed; capacity, 3,000 miners' inches; nine miles more to build to complete system. Plant partly installed as follows:—2,000 feet of 22 inch and 18 inch pipe; two hydraulic giants, having 7 inch nozzles, under 300 ft. head; sluices, distributors, etc., in place. One preliminary washing made in early spring, using water for only 47 hours, but mining work only begun. $5,161.85 in gold dust was recovered during the progress of the work. From 50 to 250 persons employed last year.

Horsefly Hydraulic Mining Co., Ltd.—On this company's claims on the Horsefly river, Cariboo district, B.C., water system has been completed, consisting of 11 miles of ditching and 1½ miles 30 inch steel pipe, with diversion dam, gates flumes and pooling reservoirs complete. Capacity, 1800 miners' inches. Portions of plant installed consist of 2,000 ft. 22 inch and 18 inch pipe; two hydraulic giants with 7 inch nozzles, sluices, etc., in place. Water was used on claim 17 days with incomplete supply, for purpose of opening pit and in preparation for work to begin next season. $13,674.61 in gold dust was recovered during the progress of the work.

Slough Creek Mining Co.—On this claim on Slough Creek, Cariboo district, B.C., the work of development was begun by drilling prospect shafts with a Chapman hydraulic jetting machine across the valley for the purpose of determining the location of the old channel. By this means a cross section of the valley from surface to bedrock has been secured. The old channel was located at a depth of 245 feet, and a working shaft is now being sunk. A drain tunnel has also been constructed 2,150 ft. long. Machinery sufficient to complete the work of development is now *en route*, aggregating over 20 tons. An average of sixteen persons were employed in 1894 and this number will be increased during 1895 as required.

Tennycape Manganese Mining Co., Ltd.—Owing to the depression in business the shipments of manganese during the past season have been very small, amounting to about 100 short tons. A great deal of development work was done on the property, and the outlook for ore and market is reported to be encouraging.

Dominion Coal Co. Ltd.—H. M. Whitney, Pres., F. S. Pearson, Consulting Engineer and J. S. McLennan, Treasurer, have just returned to Boston from one of their periodic tours of inspection in Cape Breton. The recent visit has been one of unusual interest as whilst here the directors in company with D. McKeen, M. P. their resident manager and the chief officials were able to run the first train over their new line to historic Louisburg, and also to open their fine suit of general offices just erected at Glace Bay. The past season's work was reviewed and pronounced on the whole satisfactory and extensive plans made for construction on surface and development in the mines with a view to raising 1,500,000 tons next season. The surface works include new boiler ranges at Reserve, Stirling, International and Gowrie. New bank-heads at Dominion No 1, Hub and and Reserve. Extensions of the endless haulage system at Reserve, Gowrie, International, Stirling and Caledonia and other general works of less magnitude. Mr. H. F. Donkin, C. E. will superintend the surface construction works and in the absence of Mr. McKeen (who has gone south for a three months trip for the benefit of his health) the assistant manager Mr. W. Blakemore, M. E. has been intrusted with the general charge of the mines, etc. as Mr. McKeen's deputy. We trust the latter gentleman will return with his health fully restored.

International Asbestos Mining and Manufacturing Co., Ltd.—The following circular has been issued by this Company:—"You are hereby notified that the subscriber, Receiver of the International Asbestos Mining and Manufacturing Company, has received an offer from John L. Armitage of three thousand dollars and a waiver of a claim which said John L. Armitage has or claims to have against the said International Asbestos Mining and Manufacturing Company for fifteen thousand dollars for all the factory plant and machinery at Newark, New Jersey, and the Asbestos mine in Canada, and that the subscriber, as Receiver, will report said offer to the Court of Chancery at the Chancery Chambers, in the City of Newark, on Tuesday, the 22nd day of January, eighteen hundred and ninety-five, at ten o'clock in the morning of that day, and recommend to the Chancellor at that time the acceptance of said offer of said Armitage, and ask for direction to convey the property to him. If you desire to object to the confirmation of a sale to said Armitage, you are requested to attend at the time and place above mentioned."

The Cariboo and Kootenay Prospecting and Mining Co., Ltd.—Development on the ten silver claims owned by this Company and located in the Lardeau district, B.C., is to be proceeded with this season. So far the operations of the company have been confined to a placer claim on Lardeau Creek. The creek is to be dammed and a large flume put in.

Silver Wolverine, Ltd.—This English syndicate, owning property in the Port Arthur district, Ont., and now in liquidation, will pay a supplemental dividend at an early date, and creditors who have not yet proved their claims are requested to do so before 2nd March next by communicating with Mr. C. J. Stewart, 33 Carey street, Lincoln's Inn, London, W. C. The liabilities are £772 and the assets available for dividend £14.

The Natural Gas and Oil Company of Ontario, Ltd., is applying for Ontario charter for the purpose of acquiring in the County of Essex lands or interests therein in which to sink wells for natural gas, oil and other minerals. Head office, Walkerville. Authorized capital, $500,000, in shares of $50. Directors: Hiram Walker, Detroit; S. A. King, Kingsville, Ont.; Thos. Reid, Walkerville, Ont.; C. M. Walker, Walkerville, Ont., and Hiram A. Walker, of Walkerville.

Lake Girard Mica Mining System.—Our correspondent writes: This Company's Phosphate King mine, in the Township of Templeton, is being developed with remarkable success. Originally opened for mica, from which a fair quantity of merchantable sizes have been obtained, operations have uncovered one of the largest bodies of high grade apatite found in the history of Canadian phosphate mining. The main shaft is now 70 feet deep and shows in the bottom a mass 10 feet in width, 45 feet in length, and still continuing without any sign of exhaustion or pinching with the walls. The mineral is all high grade, of pink and dark green colors, and so far but little impurity is associated with the deposit. Twenty-one persons are employed. About 1,200 tons have been mined since the 1st of January, and contracts for its sale have been made, we understand, with Mr. J. S. Higginson of Buckingham. A hoisting and drilling plant is to be put in the spring.

The Taylor Hydraulic Air Compressing Co., Ltd., has been incorporated under Dominion charter with a total capital stock of $500,000, head-quarters at the city of Montreal; to acquire the invention patented under the Canadian letters patent of invention No. 46,092 and to manufacture and sell the same. The applicants for incorporation are:—Charles Havelock Taylor, mining engineer; Henry Millen, gentleman; Walter Tylee Ross, real estate agent; Joseph Rowet Fair, accountant; Roderick Livingstone Murchison, advocate; Robert William Sutherland, accountant; and Hooper Mallet, clerk, all of the city of Montreal; and William Heber Campbell, of Belleville, barrister; James Gerald Fitzgibbon, of Norwood, banker, and Duncan Turner Ritchie, of Kelvinside, Glasgow, Scotland, gentleman.

Quebec Mining Association Smoking Concert.

Instead of the annual dinner which hitherto has been a feature of the annual gatherings of this body, a smoking concert was substituted this year, which proved a thoroughly enjoyable and successful affair. The event took place in the New Club Room, Windsor Hotel, on Thursday evening the 10th inst. There was a large attendance. Mr. George E. Drummond, of the Canada Iron Furnace Co., presided. A feature of the evening was the capital selections of the McGill Banjo and Glee Club, which were heartily applauded, and the unique entertainment provided by Mr. George R. Smith (Bell's Asbestos Co.), in his character sketch, "Why are we here?"—a humorous satire on the proceedings of scientific societies, which completely convulsed the audience. Mr. Heney, the reader of the McGill Glee Club, provided a good deal of fun by his excellent sketches of the French Canadian *habitant*. Other features of an admirable programme were the musical selections of Messrs. Haycock, Ingall and F. Cirkel, and the "Personal Reminiscences" of Mr. S. P. Franchot and Mr. Woltmann of New York. Shortly before midnight the company adjourned to the Ladies' Ordinary, where an excellent supper and a few toasts concluded the entertainment.

A Monster Wrought Steel Colliery Winding Drum.

A new conical wrought steel winding drum has just been completed by the well known English firm of engineers Messrs. H. Daglish & Co., of St. Helens. It is 33 feet on its maximum diameter and 18 feet on its minimum, 6 feet wide on the maximum diameter, and 15 feet 9 inches wide over the sides. The drum is built on three cast iron bosses, 9 feet in diameter, made in halves, with planed points and secured by strong bolts, each boss being bored to 21 in. diameter and secured to the crankshaft by four keys. The centre boss is fitted with eight pairs of arms made of flat steel bars, 8 in. by 1½ in. in section and fitted into suitable recesses prepared on the boss and bolted thereto; the bars are also bolted to a ring of plates at the maximum diameter, 16 in. by ½ in., and secured to the periphery plates by double angles. The outer bosses are fitted with discs of steel plates, 18 ft. in diameter, forming the sides of the drum, strengthened with suitable angle rings. The skeleton frame of the drum is formed of 16 main frames made of steel bars of T section, 6 in. by 5 in. by ½ in., with diagonal braces of similar section and strong gusset plates at the intersections. There are also 16 intermediate frames made of steel bars of T section, 5 in. by 4 in. by ½ in., and strengthened in a similar manner to the main frames. Additional bars of angle steel, 3 in. by 3 in. by ½ in., are fitted between the main and intermediate frames and on these, riveted to each at every intersection, is built a scroll of grooved steel of special section to receive the rope, 2 in. in diameter. Between the coils of the scroll is riveted on each frame a cast steel distance piece so as to form a continuous support to the scroll from the minimum to the maximum diameter. The outer periphery of the drum is plated with steel plates, ½ in. thick, riveted to the main and intermediate frames, with side flanges formed of angle steel, 5 in. by 4 in. by ½ in., and in the centre a groove of channel steel, 12 in. by 3½ in. by ½ in. is riveted to receive the brake blocks. The whole of the frames and side discs are secured to the side bosses by turned bolts and between the bosses are eight pairs of cast iron quill stays, with eight through bolts, 2 in. in diameter, tightening the whole structure firmly together. The engines have 45 in. cylinders by 7 ft. stroke, the load, we understand, being 4 tons of net coal and the depth of pit 763 yards.

SALE OF MINING LANDS.

IN THE HIGH COURT OF JUSTICE, (Queen's Bench Division.)

In the Matter of the Winding Up Act and Amendments thereto; and in the Matter of the Austin Mining Company (Limited).

SEALED TENDERS addressed to Peter Larmonth, Liquidator of the Austin Mining Company, Ottawa, Ontario, will be received up to two o'clock in the afternoon, on Monday, the Eleventh day of February, A.D., 1895, for the purchase of mining locations A, B and C, on the north side of Echo Lake, in the Garden River Indian Reserve, as laid down on a plan thereof dated September 3rd, 1874, fyled in the Indian Branch of the Department of the Interior at Ottawa, containing six hundred acres more or less.

There are said to be valuable mines of copper on this property.

This property will be sold subject to the standing conditions of sale of this Court, and the highest or any tender will not be necessarily accepted.

For further particulars, apply to Peter Larmonth; Messrs. MacCraken, Henderson & McKay, Barristers; and Messrs. Gormully & Orde, Barristers, Ottawa.

Dated the ninth day of January, A.D., 1895.

(Sgd.) R. B. MATHESON,
Master at Ottawa.

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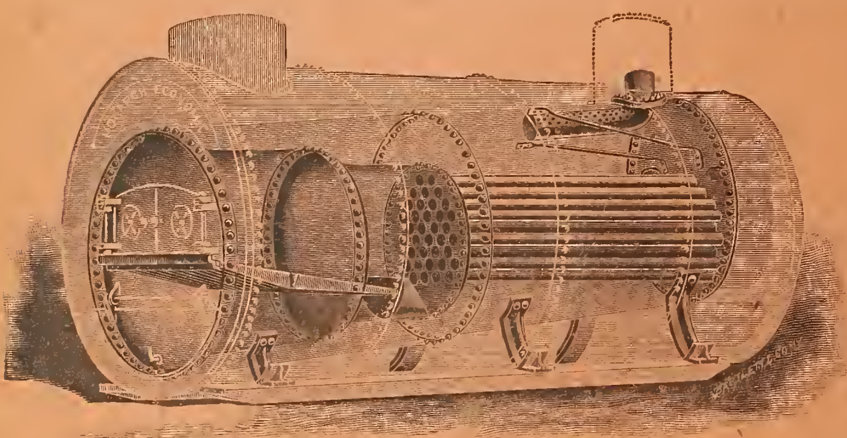

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The Canadian Mining Review

Established 1882

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FROM THE PRESS.

Dr. C. M. Percy in "The Science and the Art of Mining:"

The description of this work, as given above, will of itself be sufficient to impress its value upon our readers, and will make it unnecessary for us to deal with it at much length. The writer is one of the most eminent mining writers and mining authorities on the American Continent, and his work has had a wonderful popularity in the Dominion of Canada ; and we do not wonder at this, because there is practically nothing in connection with Canadian Mines and Miners, and Mining, that is not to be found within its pages. To the ever increasing community, interested in mining matters generally, and in Canadian mining especially, we commend with every confidence the very excellent CANADIAN MINING MANUAL, which has been an especial pleasure to us to peruse and to review.

"The Canadian Gazette," London, Eng.:

There is much to be said in praise of this handy and useful book of reference. The Canadian mining industry has of late made such progress, that a work of this kind seemed to be called for, and we do not know of anyone better qualified to undertake its compilation than the editor of that excellent journal, the *Canadian Mining Review.*

The "Citizen," Ottawa:

Mr. B. T. A. Bell has rendered the mining community a real and valuable service by compiling a volume on mining undertakings in Canada, which for fulness and accuracy of details holds a place apart in the mining literature of the country. * * * No pains have been spared to make the CANADIAN MINING MANUAL as complete a work of reference as can be desired.

"The Colliery Engineer," Scranton, Pa.:

This work is intended for the use of those doing business with Registered and Incorporated Mining Companies of the Dominion. It contains full information respecting the organization, management, capital, etc., of all important mine enterprises, and has a complete alphabetical directory of the various officials at the different mines and quarries, and of the engineers, metallurgists, chemists, and others prominently connected with the mineral industries of British America.

"The Empire," Toronto:

It is a matter of no little surprise, with the large interest involved in mining enterprises, that the want of information on this subject should have been left so long unsupplied ; but thanks to the enterprise of Mr. Bell, the public have now the fullest possible information drawn from official quarters.

"The Mail," Toronto:

We have here in the CANADIAN MINING MANUAL an entirely new publication of a decidedly useful character. The only cause for surprise—considering the importance of the position which mining affairs have attained—is that such a work has not been published before.

"The World," Toronto, Ont.:

The MANUAL should be in the hands of investors and all others interested in mining industries.

"The Financial News," London, Eng.:

A capital piece of work has been done by Mr. B. T. A. Bell in his MINING MANUAL, a handsome octavo volume, which gives a full account of every Incorporated Mining Company in Canada.

FROM THE PUBLIC.

Sir Charles H. Tupper, M.P., Ottawa:

I find this a most useful book, and you must permit me to congratulate you on the manner in which it has been prepared.

H. S. Poole, M.A., A.R.S.M., General Manager, Acadia Coal Co. Ltd., Stellarton, N.S.:

It is the most valuable new departure since the formation of the Mining Associations in the several Provinces that I am aware of.

R. G. Leckie, M.E., General Manager Londonderry Iron Co., Londonderry, N.S.:

I find it a ready and correct book of reference. It is of very great service, not only to those directly interested in mining, but to business men throughout the Dominion, containing as it does full information regarding all mining and metallurgical enterprises in Canada.

Mr. Geo. Stuart, M.E., Truro, N.S.:

It is a work highly creditable to its indefatigable author.

Mr. John Rutherford, M.E., Mount Rundell, Stellarton, N.S., (Ex-Inspector of Mines for the Province of Nova Scotia.)

I have expressed my opinion of its great usefulness before, but I may now add that the recent issue seems to me to be the perfection of a work of its kind.

Mr. T. R. Gue, President Acadia Powder Co., Halifax, N.S.:

I have perused your MINING MANUAL with much satisfaction, and consider it invaluable to the capitalist, miner and others seeking information in regard to the mining interests of the Dominion, inasmuch as it furnishes information not obtainable from any other source, even at great expense. I would recommend a copy of it to every person contemplating investment in our Canadian Mining Industry.

Mr. George E. Drummond, Managing Director Canada Iron Furnace Co. (Ltd) Montreal:

Your CANADIAN MINING MANUAL is an admirable production, and will prove a standard book of reference for everyone interested in the development of Canadian Mining interests, and this I take it should include every man of affairs in the Dominion, for with the development of our natural wealth will come increased prosperity to the nation. I have watched with pleasure the successful development of your various productions in the interests of mining in Canada, not the least of which is the MANUAL itself, and I have to congratulate you on the earnest work you have done towards awakening a proper interest in our great natural wealth.

Mr. L. A. Klein, M.E., Manager American Asbestos Co. Ltd., Black Lake, Que.:

It is the only book of its kind which affords any reliable knowledge from a business point of view.

Mr. A. Blue, Director of Mines for the Province of Ontario:

The information which it gives to persons interested in the mining industries of this country is of much value.

Mr. J. Obalski, M.E., Inspector of Mines for the Province of Quebec:

Undoubtedly of great service to all engaged in the mining industry.

Dr. E. Gilpin. F.G.S., Deputy Commissioner and Inspector of Mines for the Province of Nova Scotia:

It is often found to be very convenient in our office, and is frequently referred to.

Mr. A. W. Stevenson, C.A., Montreal:

I do not see how anyone interested in mining can well do without it.

Dr. T. C. Brainerd, President, Hamilton Powder Company, Montreal:

We find the book of much service. In view of the great importance of developing the mineral wealth of Canada we will be glad to commend your work to others, or assist in making it still more complete.

Mr. John E. Hardman, S.B., M.E., President of the Mining Society of Nova Scotia:

I like it very much indeed. Permit me to congratulate you on its fine appearance and new arrangement.

The M. C. Bullock M'fg Co., Chicago:

We thank you most heartily for the elegant copy of the CANADIAN MINING MANUAL. It contains a very large amount of valuable information, and will be a valuable addition to any mining library.

Jas. Macbeth & Co, 128 Maiden Lane, New York:

We can assure you we appreciate the MANUAL very highly. It is just what we want; and we would consider it cheap at ten times the amount.

Mr. F. J. V. Skiff, Chief of the Department of Mines and Mining, World's Fair, Chicago:

The CANADIAN MINING MANUAL is a most valuable statistical and descriptive work on Canadian mining.

Mr. Chas. Fergie, M.E., Manager, Drummond Colliery, Westville, N.S.:

I am much pleased with the last issue of the CANADIAN MINING MANUAL, and find it very useful for reference.

Mr. E. N. Robinson, Manager, Eastern Townships Bank, Granby, Que.:

I find that your CANADIAN MINING MANUAL supplies all the information I require.

Mr. J. Geo. Rutherford, M.E., Assistant Manager, Acadia Coal Co., Stellarton, N.S.:

The insertion of the mining laws of the various Provinces is a most useful addition.

The Intercolonial Coal Co., Montreal:

We have the MANUAL for 1893, with which we are very much pleased. We congratulate you on its compilation.

The Ingersoll Rock Drill Co., of Canada, Montreal:

We find the CANADIAN MINING MANUAL the most useful book in our office.

The Jenckes Machine Co., Sherbrooke:

We find the *Canadian Mining Manual and Mining Companies Directory* a thoroughly useful and practical book for a business office. We think the classification and arrangement excellent. As far as we have had occasion to use it the information therein contained is fully correct.

John Birkinbine, M.E, Past President American Institute of Mining Engineers, Philadelphia:

I find it of service in my work, for it is a useful reference.

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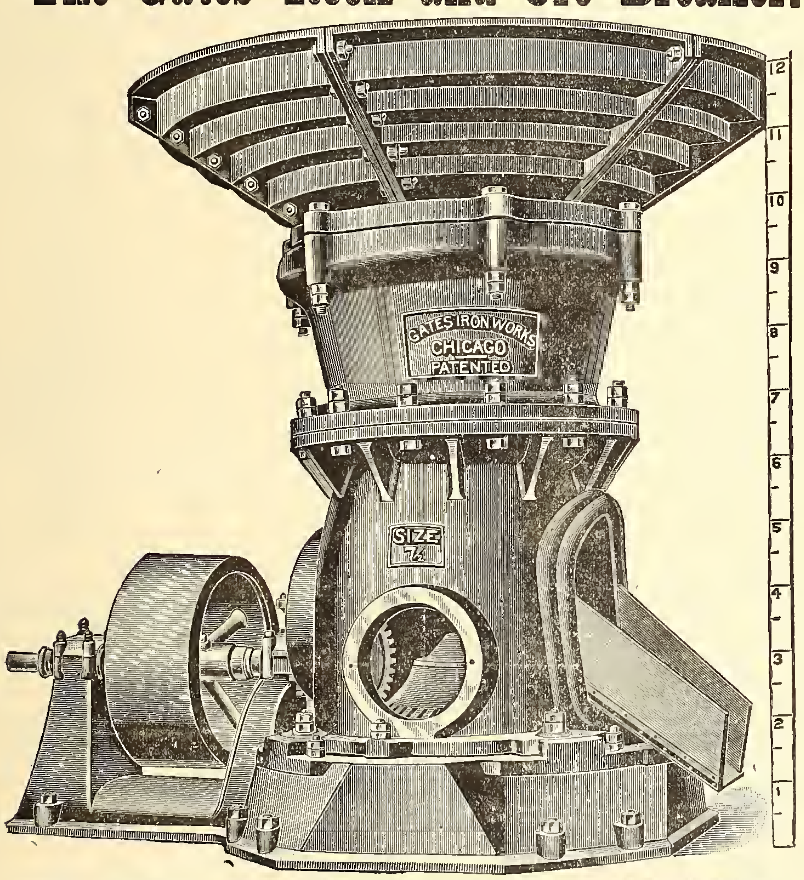

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ARCHIBALD BLUE,
Director Bureau of Mines.

TORONTO, May 25th, 1894.

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A. S. HARDY,
Commissioner of Crown Lands.

Toronto, October 17, 1894.

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The Canadian Mining Review

Established 1882

Official Organ of The Mining Society of Nova Scotia; The General Mining Association of the Province of Quebec; The Asbestos Club; and the Representative Exponent of the Mineral Industries of Canada.

B. T. A. BELL, Editor. Published Monthly. OFFICES: Victoria Chambers, Ottawa.

VOL. XIV., No. 2 FEBRUARY, 1894. VOL. XIV., No. 2

Nova Scotia Mineral Revenue, 1894.

Through courtesy of Mr. W. H. Brown, the indefatigable accountant of the Department of Public Works and Mines, we are able to furnish our readers with the official returns of the amounts received from the various mineral sources of revenue in Nova Scotia during the fiscal year ended 30th September, 1894, in comparison with the year 1892, and the nine months ended 30th September, 1893. It will be remembered that in 1893 the financial year was changed so as to terminate on 30th September, instead of 31st December, as formerly.

These tables are of the greatest value to the public, and naturally entail in their compilation an immense amount of labor on the accounting staff, which only those who have anything to do with matters statistical can appreciate at its full value.

Source.	Year ended Sept. 30th, 1894.	Year ended Dec. 31st, 1892.	9 mos. ended Sept. 30th, 1893.
Prospecting licenses (gold)	$ 7,856 00	$ 7,371 98	$ 3,767 00
Rents (gold lease applications)	1,752 00	1,926 00	1,262 35
Gold rentals	2,599 00	1,653 50	1,443 00
Gold royalty	7,517 01	8,199 42	5,721 11
Licenses to Search	5,190 00	5,040 00	15,720 00
Leases—Minerals other than gold & silver	2,300 00	1,925 00	2,250 00
Rentals do do do	5,340 00	3,030 00	2,460 00
Coal royalty	209,330 52	135,962 80	142,058 25
Iron royalty	168 60	180 50	120 16
Fees	604 75	408 10	404 00
Totals	$242,657 88	$165,697 30	$175,205 87

Memo. showing amounts received by the Department of Mines, Nova Scotia, during year ended Sept. 30th, 1894, also for the nine months ended Sept. 30th, 1893, from the various sources in connection with minerals, other than gold and silver in undermentioned counties.

LICENSES TO SEARCH.

	9 mos. 1893.	Year 1894.
Cape Breton	$5,950 00	$1,530 00
Cumberland	2,670 00	1,320 00
Inverness	1,740 00	900 00
Pictou	1,490 00	330 00
Antigonish	570 00	120 00
Victoria	870 00	210 00
Richmond	1,890 00	120 00
Other counties	540 00	660 00
	$15,720 00	$5,190 00

Decrease in 1894, $10,530.

LEASES OF MINERAL OTHER THAN GOLD AND SILVER.

	9 mos. 1893.	Year 1894.
Cape Breton	$1,200 00	$1,050 00
Cumberland	150 00	300 00
Pictou	300 00	350 00
Inverness	350 00	450 00
Other counties	250 00	150 00
	$2,250 00	$2,300 00

Increase in 1894, $50.

RENTALS—MINERALS OTHER THAN GOLD AND SILVER.

	9 mos. 1893.	Year 1894.
Cape Breton	$ 600 00	$1,950 00
Cumberland	690 00	1,560 00
Pictou	780 00	870 00
Inverness	180 00	390 00
Colchester	30 00	150 00
Other counties	180 00	420 00
	$2,460 00	$5,340 00

Increase in 1894, $2,880.

COAL ROYALTIES.

	9 mos. 1893.	Year 1894.
Cape Breton	$82,011 39	$114,111 57
Cumberland	33,350 65	46,938 22
Pictou	26,316 33	48,241 00
Other counties	379 88	39 73
	$142,058 25	$209,330 52

Increase in 1894, $67,272.27.

Iron Royalty—Pictou County, 1893, $120.16; in 1894, $168.60.

Memo. showing the amounts by Counties received by the Department of Mines, for the year ended Sept. 30th, 1894, in connection with gold.

PROSPECTING LICENSES.

Guysborough	$3,174 50
Halifax	2,132 50
Lunenburg	674 50
Queens	657 00
Hants	401 00
Victoria	386 00
Yarmouth	133 50
Other counties	297 00
	$7,856 00

RENTS (GOLD LEASE APPLICATIONS).

Guysborough	$ 690 00
Halifax	542 00
Hants	190 00
Queens	136 00
Lunenburg	96 00
Yarmouth	62 00
Victoria	30 00
Othor counties	6 00
	$1,752 00

GOLD ROYALTIES.

Halifax	$4,172 26
Guysborough	2,013 36
Hants	870 87
Queens	305 50
Lunenburg	83 72
Yarmouth	71 30
	$7.517 01

GOLD RENTALS (YEARLY PAYMENTS ON LEASES).

Halifax	$ 841 50
Hants	528 00
Guysborough	473 00
Queens	281 00
Lunenburg	276 00
Colchester	95 00
Yarmouth	69 50
Victoria	35 00
	$2,599 00

CANADIAN PIG IRON STATISTICS, 1894.

The Following Table has been Compiled from Returns kindly furnished by the Officers of the Respective Companies For the Year ended 31st December last.

Company.	Situation of Furnace.	Quantity Pig Iron Manufactured	Value at Furnace.	Total Ore Charged.	Fluxing Material Used.	Fuel Charged.			Persons Employed
						Coke.	Coal.	Charcoal.	
Londonderry Iron Co. Ltd.......	London, N.S..............	10,252 $\frac{15}{2000}$	$123,033	22,299	7,639	11,475	4,282	......	225
N. Gl'gow Iron, Coal & Ry. Co. Ltd	Ferrona, N.S................	28,142 $\frac{1600}{2000}$	295,500	60,817	22,928	42,378	......	......	450
Canada Iron Furnace Co. Ltd....	Radnor, Que..........	7,900	190,000	17,500	1,750	......	......	756,000	600
Pictou Charcoal Iron Co. Ltd....	Bridgeville, N.S.......	1,720	....	3,600	440	......	......	200,000 (bush.)	120
J. McDougall & Co.............	Drummondville, Que..........	No report	furnished. Ab	out 5000 tons	charcoal iron	estimated.	......	......	....

Note—Londonderry Iron Co's retnrns cover only six months operations, furnace being relined. Canada Iron Furnace Co's number employees include other operations of this Company.

NOVA SCOTIA COAL DISPOSALS, 1894.

From Returns furnished "The Review" by the Courtesy of the Officers of the Respective Companies for the Twelve Months ended 31st December.

Company.	Nova Scotia.	New Brunswick	Quebec.	P. E. Island.	United States.	West Indies.	South America.	St. Pierre Miquelon.	Newfoundland.	Mexico.	Bunker Steamer.	Other Countries	Employees.	Engines.
Dominion Coal Co. Ltd.........	163,911	28,202	553,781	11,746	53,894	7,409	521	2,620	58,954	1,527	49,163	..	14,490	43,849
Cumberland Ry. & Coal Co. Ltd.	123,795¼	126,057¼	98,913½	....	36,205	....	..	....	....	....	....	..	....	......
Intercolonial Coal Co. Ltd.......	100,508	7,240	80,687	15,339	3,059	1,052	536	....	....	....	....	270	4,873	11,449
Acadia Coal Co. Ltd	126,836	7,199	5,129	25,950	....	....	.	144	....	....	....	..	5,514	25,631
Canada Coals & Ry. Co. Ltd	11,894	56,558	15,800	401	7,347	....	.	....	....	....	....	595	1,648	8,381
Cape Breton Colliery	6,036	898	900	2,331	....	....	..	....	3,915	....	....	..	313	2,098
General Mining Assocition Ltd...	Given in ag	gregate bel	ow.	....	....	....	..	....	....	....	....	..	....	......

RECAPITULATION.

Company.	District.	Disposals, 1894.	Remarks.
		Tons.	
Dominion Coal Company	Cape Breton..............................	990,067	Includes employees and engines.
Cumberland Railway and Coal Company..................	Cumberland County.....................	384,971	Does not include employees and engines.
Intercolonial Coal Company................................	Pictou County..........	224,743	Includes employees and engines.
Acadia Coal Company....................................	do	226,442	Includes employees and engines.
Cape Breton Colliery..................	Cape Breton	17,086	Includes employees and engines.
General Mining Association	do	223,000	Does not include employees and engines.
Canada Coals and Railway Company...................	Cumberland County.....................	102,031	Includes employees and engines.
Total for the 12 months ended 31st Dec., 1894......		2,168,340	

Mr. R. T. Hopper, Montreal,

Managing Director Anglo-Canadian Asbestos Company, Ltd.

The New Director of the Geological Survey.

After twenty-five years faithful service, Dr. A. R. C. Selwyn, C.M.G,, has been superannuated and Dr. George M. Dawson, C. M G, has received the appointment of Director of the Geological and Natural History Survey of Canada. Although yet but a comparatively young man, Dr. Dawson has earned an enviable reputation as a geologist and a scientist, his latest and perhaps most important public service, being that of a British Commissioner on the Behring Sea Commission.

He was born in Pictou, N. S. on 1st August 1849 and is the son of Sir William Dawson, the venerable ex-principal of McGill University, Montreal, whose researches in geology are well known. He received his early education in Montreal, but did not enter the University except as a partial student, in consequence of delicate health. In 1869 he entered the Royal School of Mines, London, and took its full course of study extending over three years. Here he devoted special attention to geology and palaeontology, under the able tuition of Ramsay, Huxley and Etheridge, and to chemistry and metallurgy in the laboratories of Frankland and Percy. He held the Duke of Cornwall's scholarship, given by the Prince of Wales; he also took the Edward Forbes medal for palaeontology and the Murchison medal in geology. On returning to Canada he was engaged for a year in mining surveys in Nova Scotia and in lecturing in Morin College, Quebec.

The first work of any importance in which he was engaged was in 1873, when in the capacity of geologist and naturalist to Her Majesty's North American Boundary Commission he investigated the country in the vicinity of the boundary line between Canada and the United States from the Lake of the Woods to the Rocky Mountains. The information thus gathered was, at the end of the Commission's work in 1875, published in the form of a report entitled "Geology and Resources of the Forty-ninth Parallel," and this amongst other things gave the first detailed account of the Souris coal fields, though some of the sections along the Souris bed had previously been visited by Dr., afterwards Sir James, Hector. The economic results of this were important as setting at rest the question of a fuel supply for the prairie country. In July of the same year began his connection with the Geological Survey, with which he has ever since been identified. His first important trip in his new appointment was to British Columbia where, until 1879, he was engaged in the exploration and geological survey of the Province. This has been the scene of his labors ever since, with very little exception, and the knowlege obtained of the geological structure, and the geological mapping of British Columbia, so far as it has gone, is almost entirely due to the energetic work of Dr. Dawson. From that time until 1882, he continued his labors in that Province and in the North-West Territories. In the latter year he went to Europe, where he travelled extensively, vsiting mines, metallurgical works, museums, etc. His most arduous journey after his return was with the Yukon expedition, of which he was selected by the late Hon. Thos. White to take charge; a very complete report of which has recently been published by the Geological Survey. The route he chose for himself, although of a most difficult nature, was taken as that most likely to afford the most information regarding the geology of the vast and virtually unknown tract of country he was about to explore. His journey was 1,300 miles in length, from the mouth of the Stikeen river, by way of the Dean, Upper Liard, Pelly and Lewis rivers back to the coast. Nearly the whole distance was traversed by following the rivers; some of these had in former years been used by the Hudson's Bay Company, but they had long heen abandoned as a trade route, and were at the time of his expedition almost unknown geographically. The difficulties encountered were very great,—boats had to be built at several points, and one portage of fifty miles was made through the woods in crossing from the drainage-basin of the Liard to that of the Yukon,—but all were surmounted and the expedition successfully accomplished its work.

Details of Dr. Dawson's travels throughout British Columbia and the North West will be found in the reports of the Geological Survey. He is the author of fifteen separate reports, of which the following may be referred to as of most importance: On the Queen Charlotte Islands, including as an appendix a monograph on the Haida Indians (1878). On an exploration from Port Simpson on the Pacific Coast to Edmonton on the Saskatchewan (1879). On the Region in the vicinity of the Bow and Belly Rivers (1882-4). On the Physical and Geological features of part of the Rocky Mountains (1885). Notes to accompany a Geological map of the Northern portion of the Dominion of Canada (1886) Author (with Dr. Selwyn) of Descriptive Sketch of the Physical Geography and Geology of Canada (1884). Author (with Dr. W. F. Tolmie) of Comparative Vocabularies of the Indian Tribes of British Columbia, with an Ethnological map (1884). It is unnecessary to particularize the numerous and valuable original scientific papers on the geological, geographical and ethnological observations made in the course of his explorations and contributed to various scientific journals; their value is well known and fully appreciated.

EN PASSANT.

The annual general meeting of the Mining Society of Nova Scotia will be held in the rooms of the Society on 13th proximo, when an interesting programme will be submitted. The annual dinner of the Society will be held in the evening.

Mr. Charles Fergie, M.E., Manager of the Drummond Colliery, who has been spending a few months well earned holiday among his people in England, is expected home by the beginning of the month.

Mr. Henry S. Poole, M.E., A.R.S.M., General Manager of the Acadia Coal Co., and Mr. David McKeen, M.P., Resident Manager of the Dominion Coal Co., Ltd., have gone for a three months' holiday on the Mediterranean.

The Kingston Mining School was formally opened on Friday, 4th ulto., when a large company witnessed the operations of the small Nissen mill, Frue vanners, Blake crusher and other plant recently installed by enterprise of the governors of Queen's University. Writing to the Robb Engineering Co., which furnished one of their excellent engines and boilers, Principal Grant says: "The Ontario Mining Institute held its quarterly meeting here last week, and we took that occasion of formally opening the mining laboratory; and your engine and boiler were both voted satisfactory. As a Nova Scotian, I was delighted that we had so much of our machinery from Nova Scotia, and as this is the only mining laboratory in the country I was delighted that you had contributed to its equipment." By the way our manufacturers of mining machinery can aid the operations of this deservedly creditable educational institution by donations of working models of their special lines of mining machinery and any such is certain of cordial acknowledgment from Dr. Goodwin, the Director.

Mr. John Blue, C. & M. E., President of the General Mining Association of Quebec, has invited the mining students at McGill to spend a few weeks at the Eustis mine, an example which might very well be imitated with advantage to the extension of mining education in Canada by other of our mineral operators.

Mr. R. T. Hopper, whose portrait we have pleasure in reproducing on another page, is one of the pioneers of the Canadian asbestos industry, having been one of the first on this side to discover the great commercial value of the mineral and to demonstrate its superiority in competition with the Italian product, which then monopolized the European market.

He ultimately succeeded in promoting the formation of the Anglo-Canadian Asbestos Company, Ltd., an English syndicate which has operated successfully for a number of years an important territory of mineral land at Black Lake, Que., and which, under Mr. Hopper's careful, judicious and enterprising management, occupies to-day a foremost place among our dividend paying asbestos mines. Mr. Hopper is also a director of the Montreal and Kootenay Mining Company, Ltd., operating silver-lead claims on Kootenay Lake, near Ainsworth, B.C., and of the English Portland Cement Company, Ltd., whose works and quarries are at Marlbank, Ont. In addition to these enterprises Mr. Hopper has been intimately associated for many years with the phosphate and mica industries of Quebec and Ontario. He takes a lively interest in the welfare and doings of the Quebec Mining Association, of which he has been an officer and an active worker since its organization.

Apropos of Captain Adams' remarks before the Quebec Mining Association, it might be added that the Dolcoath tin mines in Cornwall, on an outlay of about £45,000, has paid dividends to the amount of upwards of £910,000. The shares, on which £9 12s. 6d. each had been paid, were now worth upward of £70.

Mr. James Conmee, M.P.P., President of the Ontario Mining Institute, has, we are glad to learn, been re-elected member for Algoma in the Ontario Legislature. This is as it should be, for, apart altogether from politics, with which happily the REVIEW has no concern, Mr. Conmee is a good fellow, who has a live interest in Ontario mining affairs, and who may be relied upon always to do his best for the industry in the Legislature. We extend our congratulations.

The Grand Trunk coal contract one of the largest railway contracts of the year has gone at very low prices. The deliveries include 400,000 tons at Suspension Bridge, 85,000 tons at Montreal, 40,000 tons at Brockville, 35,000 tons at Chaudiere Junction, 30,000 tons at Portland, and 50,000 tons at Detroit, Although the greatest secrecy is maintained by the officials of the company the result of the deal is approximately as follows:—At Montreal, Dominion Coal Co., 50,000 tons, Intercolonial Coal Co., 35,000 tons: at Chaudiere, Cumberland Ry. and Coal Co., 35,000 tons: at Portland, Reynoldsville coal from the Rochester and Pittsburg Iron Co., at about $2.80: at Brockville, O. W. Shipman, at about $2.60: the 400,000 tons at the International Bridge was purchased at about $1.45, or say 15 cents under last year, but the distribution is kept a close secret at this moment.

The annual general meeting of the Ontario Mining Institute, which according to constitution should be held in Toronto 6th March, has by resolution of Council been postponed to Wednesday and Thursday the 10th and 11th of April. In addition to the election of officers and other business, a number of papers will be read, including contributions as follows:—"Modern Machines and Appliances for Concentrating Works," by Mr. F. Hille, M.E., Port Arthur; "Investment in Mining Properties," by Mr. J. J. Kingsmill, Q.C., Toronto; "Electricity in Mining," by Mr. Rosebrugh, of the School of Practical Science; Dr. Ellis, of the School of Practical Science, and others.

We learn that through the generosity of Mr. W. Bruce Carruthers of Kingston, a scholarship of the value of $350.00 per session has been founded in the School of Mining to be awarded to the most deserving student of mining engineering.

Mica as a decorative element has often been suggested, says an exchange. A celebrated Bavarian decorator, Fr. Nauset, says that he made his first trials with the liquid mica, and the effects obtained came fully up to his expectations. Mica is white, more or less transparent, and has a gloss similar to silver. It does not cover sufficiently and needs ground. Therefore, if a silver gloss is wanted, the ground has to be laid in with clear white distemper color. After the distemper color is dry, have it glazed over with the liquid mica, reduced by fifty per cent. of water or more, using a soft camel's hair brush. If one coat does not answer, it can be done over. When the coat of mica is dry, ornaments can be put on. If it appears too light a netting may be stenciled on. If other than silver grounds are wanted, add distemper colors in small quantities to the liquid mica as furnished by the manufacturers, mix well on the pallette, and when mixed reduce by water ready for the brush. Then give one or two coatings to the ground. If the liquid mica is used colored, the ground should be colored to match.

At a recent meeting of the Yorkshire College Engineering Society, a paper upon "The Theory and Practice of Coal-washing," was read by Mr. J. Clark Jefferson, Wh. Sc. The lecturer commenced by pointing out that the removal of clay, slate and other earthy matters from coal led to increased efficiency of the fuel, and that the money thrown away by the consumer in paying coal price for the ash in 1 ton of coal unwashed is more than the cost of washing that quantity. It therefore follows that clean coal is actually cheaper at the higher price necessary to cover the cost of washing it. The description of the different classes of coal-washing machines which followed showed that all washing operations differ only in the manner in which the water is employed. The different modes of washing are—the fall of the material in still water; separation under the influence of an upward and a downward current; separation by means of a horizontal current and by means of an inclined bed, leading to a sliding or a rolling transport of the material; lastly, by the influence of a rotating fluid. From theoretical considerations, it was pointed out that in jigging machines the rise of the water was advantageous, but a rapid fall was distinctly disadvantageous; also that rotary separators were the worst of all machines for washing coal. It was also shown that if the operation was effected under the influence of a rapidly-recurring upward movement of the fuel through stationary water, so that each interval of time was under one-fifth of a second, then the clay would separate from the coal; also the separation was shown to be independent of the size of the particles when screened for the market.

Here's a pretty story from Johannesburg:—"A most extraordinary accident happened in the public street lately, no reference to which has appeared in the daily papers. As is well known, the road metal employed by the Sanitary Board for making the streets is a hard waste stone obtained from some of the mines. Whilst the steam-roller was at work the other day, the driver suddenly experienced a tremendous shock, being thrown into a dazed condition; and the heavy engine was thrown back at least a foot. It must have passed over a portion of an unexploded dynamite charge. Had any lighter vehicle passed over the charge it must have been blown to pieces."

At a recent meeting of the Société d'Encouragement, in Paris, M. Osmond, the well-known metallurgist, brought to the notice of members the results of his recent experiments in the field of metallography, and presented a method, capable of being practically adopted in works, of making a microscopic analysis of steel. The method comprises, independent of the preparatory polishing, three operations—(1) a polishing in bas-relief on parchment, with a small quantity of brown, red and water; (2) an attack-polishing, on parchment, with sulphate of precipitated lime and an infusion of liquorice root; (3) an attack or application of tincture of iodine or azotic acid. These three operations permit of five constituents being traced in steel, of which two are known and have been well defined, a third known but not well defined, while the other two have hitherto remained unknown. These five constituents are;—(1) "Ferrite," or the iron itself, fairly pure; (2) "cementite," or carburet of iron conforming to the formula Fe_3C; (3) "sorbite," which accompanies the cementite, and where the carbon appears to be in the state of carbon due to hardening; (4) "martensite," the principal constituent of hardened steels, consisting of small crystals of iron containing the carbon due to hardening in solution; (5) "troostite," which comes next to martensite in hardened steels. These five constitutents, between which certain transition forms are found, join together in multiple combinations and in building up the complex structure of steels. Experiments made by M. Osmond, with four different steels, each having a larger content of carbon than the other, show how these combinations vary; —(1) With the degree of heat; (2) with the degree of heat in hardening; (3) with the rapidity of the cooling. From the experiments made, the inference is drawn that the different conditions of thermic treatment of the steels leave behind in the structure of the cooled metal characteristic indications of sufficient precision to enable the manufacture to be accurately carried on to the desired specification. M. Osmond supported his conclusions by a number of enlarged micro-photographic slides projected on the screen, showing the aspect of the different steels in their different conditions.

The British Board of Trade has just issued a volume of "Instructions to Surveyors" respecting surface ventilation of coal cargoes. These instructions are to be acted upon by the surveying staff whenever the principal officer of the distaict finds it necessary to order a coal laden vessel to be detained owing to insufficient surface ventilation, or to defective construction of the cowls or the deck fittings. The following are among the chief provisions of the instructions: Surface ventilators for coal-laden ships should be made entirely of wrought iron. Ventilators are to be fitted with cowls. In cases where the cowls are attached to the weather deck alongside a raised forecastle, poop, or bridge-house, the lower edge of the cowl should be six feet above those erections. The openings for ventilators in the upper deck, poop, or forecastle should be fitted with frames or lids, the lids, when not in use, being stowed on edge or in any other suitable way inside the lower portion of the ventilators. In vessels with more than one deck, substantial wrought-iron pipes should be led in from the ventilators on the upper deck, poop, or forecastle to the compartments in which the coal is stowed. The ventilators should always be placed in sheltered positions, and means should be provided for stowing the cowls, etc., when, from heavy weather it is found necessary to unship them from the portions secured to the deck A table is given showing the minimum diameters of the weather deck ventilators up to 24 in. diameter. The surveyor must warn those in charge of the ship of the danger that may follow the presence of gas in the forecastle, cabins, &c., through leakage, and should caution masters that taking naked lights or striking matches in holds or places below the deck is always a most reprehensible practice, and in coal-laden ships especially is attended by very great danger. With respect to coal bunkers, in the case of "present use" bunkers, the covers of which are usually left off, the surveyors need not insist on the provision of ventilators, unless there are particular reasons rendering them necessary. As regards "reserve bunkers," however accumulations of coal-gas are sure to occur if the bunker openings are closed, and ventilators should, therefore, always be provided. Suitable plugs and covers or other efficient appliances should always be provided for closing the apertures of ventilators in bad weather.

The reduction of the refractory earths, such as alumina, glucina, &c., or a quick manufacture of small quantities of their alloys, must have often been a question of serious drawback to demonstrators whom the oxyhydrogen flame refused to satisfy. An electric furnace for the lecture table has been patented in England by a Mr. H. N. Warren, and is being supplied to the universities. It consists, so far as the furnace is concerned, of an outward jacket of caloric cement, through the bottom of which passes a plumbago tube, while a rod of the same material is inserted through the top of the furnace, and so regulated as to allow of the arc produced to play upon the compound placed in the cavity. Connected to the furnace is a small plant of special construction and capable of evolving a voltage of 100 deg. intensity, or can be readily arranged for amperical value as required. Nearly every substance brought within the cavity is at once reduced and a corresponding button of metal obtained, the furnace also being arranged with a side communication, whereby a small arc is obtained for the reduction of minerals. In this instance, the mineral to be tested is first finely ground and made into a paste with solution of pyroxlin and afterwards rolled into a small stick; on bringing the same into contact with the flame from the carbon points reduction at once takes place, with the production of a metallic bead; the electric plant is also arranged entirely automatic, and the furnace can be put into action instantaneously.

At a recent meeting of the Institution of Civil Engineers, London, Eng., Mr. E. B. Wain, contributed an interesting paper on "Colliery Surface Works." As an instance of the development of mining operations during the past twelve years, the North Staffordshire coal field was cited, where the output had been increased 40 per cent., and this was due to the fact that there was hardly a colliery in the district the plant of which had not been considerably improved during the period referred to. It was of the highest importance that the works should be concentrated as far as possible, so as to permit efficient supervision and to reduce the staff of mechanics and general laborers. An example was mentioned of a colliery, where in 1876 six small and scattered plants were at work on the property and were raising less than one-half of the material now being obtained from two shafts. Where practicable the railways should be arranged so as to allow a gentle descent for wagons to and from the screens; if the nature of the ground would not admit of this, endless ropes working between the rails were of great service. The subject of screening and picking apparatus would in itself afford material for a lengthy paper; the author therefore only briefly noticed some of the types of screen in general use. The writer was of opinion that it was not advisable to undertake new work of importance in colliery workshops, but to use them simply for the purpose of making such repairs as might be necessary. The economy of fuel in colliery work had received too little attention in the past, the boilers being often supplied with inferior coal or slack which had been considered unsaleable. The amount of coal consumed in colliery work was probably not less than 5 per cent. of the total output of the kingdom, and as slack had now become more valuable, colliery engineers were beginning to give greater attention to the questions of compound working, expansion-gear, condensation, and balanced loads.

Some interesting facts respecting the curvature of diamond drill holes have been brought out by Mr. J. Parke Channing in a paper before the Lake Superior Mining Institute. While drilling a series of fan holes to test the formation of one of the Michigan ranges Mr. Channing found that cores from holes started downward at an angle of 45° did not correspond with the calculated stratification at the supposed position of the bottoms of the holes. Concluding that the angle must have changed, he proceeded to test this by the method of lowering glass tubes containing hydrofluoric acid and noting the angle of the etched ring. The first trial not wholly conclusive, indicated that at a depth of 531 feet the hole had flattened 15°. After experiencing trouble with different forms of apparatus, the results being vitiated by the hydraulic pressure driving stoppers in and compressing the air, or forcing in water through the plugs and diluting the hydrofluoric acid solution, successive experiments giving no test, Mr. Channing had special tubes made, 1 inch in diameter, 5 feet long, with ground glass stoppers. These also failed at first, the water working in through the ground joint. The final and successful method was in brief as follows:—The vacant end of the core barrel was plugged tightly with wood; the upper end of the tube warmed and the stopper heated in a little paraffine; the tube placed vertically; 1 inch of

20° acid carefully poured in, then 1 inch of water; the stopper fitted in; the tube, still vertical, was put in the core shell and the latter screwed into the barrel. The apparatus was then lowered with the rods, care being taken to touch the bottom of the hole gently. Experiments as to the time necessary to leave the tube in the hole showed that two hours were as good as twenty-four, but that one hour was insufficient. The angle of etching was read by clinometer. It was also proved that the rods would turn freely with considerable curvature. In some of the deep holes the point was 60 feet higher and 50 feet farther than if drilled straight. Lateral deviation could not be tested by a tripped compass, on account of local irregularities of attraction. The cause of the holes flattening was found to be that with a new bit on an old core barrel the upper end of the latter had an extra clearance and tended to press down, thus gradually raising the direction of boring. In another part of this issue we reproduce a sketch of Mr. Channing's apparatus.

The De Beers Consolidated Mines (South Africa) during the past twelve months produced diamonds which realized £2,820,172. The total expenditure amounted to £1,690,584, leaving a profit of £1,129,587; and after paying two dividends of 12½ per cent., there was a balance of £726,666 to carry forward. The value per load of material removed was £1 1s. 10½d.

In a lecture on blasting explosives, given at the Society of Arts, Professor Vivian B. Lewes, of the Royal Naval College, Greenwich, made some interesting remarks upon the cause of explosions in dusty mines free from fire-damp. He pointed out that until quite recently explosions in mines were always attributed to the accidental ignition of mixtures of air and methane, to which the name of fire-damp was given, and undoubtedly this cause was the prime factor in this class of disaster, and the introduction of such precautions as safety-lamps at once brought about a considerable reduction in the number of explosions taking place. It was found that explosions in mines might be brought about—first, by the ignition of a mixture of methane and air, in which the former rose above a certain percentage; secondly, by mixtures of air, coal-dust and methane, in which the amount of the last mentioned may be excessively small; lastly, by mixtures of coal-dust and air. In cases recently investigated powder was the blasting agent used, and such powder as was employed for this purpose gave, amongst the products of combustion, nearly half the volume of permanent gases in the condition of carbon-mon-oxide, methane and hydrogen. The experiments and investigations in various colliery explosions made it abundantly manifest that no explosive should be licensed for use in mines unless it could be absolutely proved that it gave off no inflammable products of combustion. He urged the absolute necessity of legislative enactments at once forbidding the use of blasting powder in any coal mines, no matter how free they might appear to be from fire-damp, or from dust; and if they examined the returns made as to deaths caused by gunpowder, and other explosives in mines for the year 1892, it would be clearly seen that the exclusion of gunpowder in handling alone would do away with 80 per cent. of the accidents, whilst if explosives of the Sprengel class were employed accidents due to the explosives used would be practically eliminated from the mining death-roll, and it was only a question of time as to when England would follow the action of France and Germany in altogether prohibiting the use of blasting powder in dusty mines.

A hand boring machine for making advance bore-holes in the seam, and thus facilitating the bringing down of coal, is made by Heinrich, Sellerbeck & Co., of Oberhausen, Rheinland. The spindle with its mitre gear is carried by a channel iron joist, one end of which is inserted in the floor of the seam, while the other is carried by a log clamped to timbers laid against the roof, and further strengthened by suitable struts. The forward feed is given by a screw easily operated by the man who turns the boring rod. The cutting end is made in the shape of an auger, and the various lengths of rod are connected by joints screwed with the Whitworth thread, which the firm has found to be the best and most practical, giving the rod the greatest amount of stiffness. It is asserted that if a free space for working about 1½m. (say 5 feet) high, be left over the machine, an advance of 2 to 2½m. may be made in the hour, and a man new to the work can become an experienced *Bohrmeister* after drilling the first hole.

Asbestos has been recently announced to be magnetic. Pieces of asbestos millboard were, it is said, attracted to a strong electro-magnet and, moreover, proved to be capable of being permanently magnetised. This property of asbestos is attributed to the oxide of iron it contains, although the proportion of this substance is exceedingly small.

At a general conference of representatives of the various collieries in South Wales and Monmouthshire, held at Cardiff, the report of the Commission appointed to consider the subject of explosives in mines was brought forward. The points reported upon were:—(1) The strength and cost of high explosives as compared with ordinary gunpowder; (2) the effects of high explosives in producing small coal as compared with ordinary gunpowder; and (3) the comparative safety of the above mentioned explosives. After a very careful consideration of the tests, the Commission unanimously arrived at the following summary of conclusions:—1. That we consider carbonite a safe and effective explosive for blasting hard top or bottom, such as rock or clift. 2. That for blasting in the coal we consider that the meal gunpowder, with the ammonia preparation, is as safe as any of the high explosives used, at present whilst it retains in every respect the properties of ordinary loose powder for spreading and not crushing the coal. 3. That carbonite, when used in the coal, produces a large quantity of small coal in the immediate vicinity of the explosion or back of the hole. The report was received with general satisfaction, and the Commission was awarded a vote of thanks.

Mr. E. C. Potter thus explains the use of flux in the blast furnace: "The office of flux is to remove the earthy impurities of the ores. For this purpose limestone is usually employed. The way in which this is accomplished is rather an intricate chemical reaction, but stated as simply as possible the reaction is as follows: The principal earth associated with the ore is common clay, or silicate of aluminum, as it is chemically called. This material, as every one knows, is quite infusible and hence impossible to remove by the mere application of heat. It is a chemical fact, however, that by the addition of lime to the silicate of aluminum, forming the double silicate of lime and aluminum, this double silicate, being quite fusible, and being lighter than the metallic iron, floats upon its surface, and is thence drawn off."

Messrs. E. H. Sargent and Co., Chicago, U. S. A., have introduced an improved assay furnace, which consists of an almost square sheet iron frame, 23 in. high, 14 in deep and 16 in. wide, lined with firebrick in sections, the interior being smooth and straight from top to bottom. The cover, which is of cast iron, is ridged to lessen the danger of cracking. The muffle door, also of cast iron, is fitted with a circular opening filled with mica, so as to enable the operations to be seen when the door is closed. The draught doors are also of cast iron, and are provided with steel openings to further regulate the draught. Circular holes in all four sides of the bottom serve to keep the furnace cool. The muffle rests equally upon the firebrick in front and in the rear, leaving a space of 1½ in. between the end of the muffle and the brick to allow the passage of fumes. There is also a space of 4 in. on each side of the muffle for fuel The furnace will take a muffle 12 in. long 6 in. wide and 4 in. high. Its total weight is said to be 155 lbs.

A Committee of the North of England Institute of Mining and Mechanical Engineers has been investigating the subject of flameless explosives. After careful investigation and experiment, the following conclusions have been deduced:

1. All the high explosives (ammonite, ardeer powder, bellite, carbonite, roburite, and securite) ere less liable than blasting powder to ignite inflammable mixtures of air and fire-damp. These explosives, however, cannot be relied upon as ensuring absolute safety when used at places where inflammable mixtures of air and fire-damp may be present.

2. The variable results following upon the detonation of high explosives appear to be due in some measure to defective admixture of, or variation in, the proportions of the ingredients used in the manufacture of the explosive.

In view of the changes from time to time made in the proportions and constituents of high explosives, it seems desirable that this information should be afforded by the manufacturers to the users of the explosive.

3. In the storage of high explosives it is desirable that every care should be taken to ensure their being maintained in a proper condition. It is also certain that these explosives alter in character with age.

4. It is essential that similar examinations of the working places and precautions which are in force in mines where blasting powder is used, should be rigidly observed when a high explosive is employed.

5. In selecting a high explosive for use in a mine, it should not be forgotten that the risk of explosion is only lessened and not abolished by its use.

6. All the high explosives on detonation produce evident flame.

7. The emission of flame from a blown out shot of a detonated high explosive is not prevented by the quantity or length of stemming used.

8. In the case of a charge of a high explosive which has missed fire, if a short length of stemming (proved up to 8in.) has been employed, the charge can be detonated by another cartridge of the explosive and additional stemming being placed in the hole in front of the original stemming.

A most ingenious method has been used in England for ascertaining the constituents of air during an explosion. A charge of blasting powder was fired from a cannon suspended in a shaft, the air of which was proved, by careful chemical analysis, to be absolutely free from any trace of combustible gas. In order to get some idea of the condition of the air inside the pit during the explosion, samples of air were taken and were analyzed. Two brass tubes were fastened to the rope that was used to lower the cannon, one 20 yards from the bottom, the other 40 yards from the bottom. These tubes were so arranged and constructed that the explosion, as it passed the tubes, unsealed the outlet pipe, and the escaping water sucked in a sample of air, which was trapped by a special arrangement and kept in the tube until the rope could be wound up. By this method it was intended that the sample of gas taken should represent that state of the air whilst the flame was passing or directly afterwards. The tube nearest the bottom, as the following analysis shows, did partly collect the gas in the above condition. The tube at the top, however, commenced to act prematurely, and was probably started by the sound wave which preceded the explosion. This tube simply contained ordinary air. The following is an analysis of the gases found in the lowest tube:

	Per cent.
Oxygen	3.9
Nitrogen	75.9
Carbon dioxide	12.1
Carbon monoxide	8.1
	100.1

This ingenious arrangement was due to Mr. W. J. Orsman, and it is probably the first successful attempt which has been made to get a sample of gas during the progress of explosion; and there is not the slightest doubt that the presence of such an amount of carbon monoxide converts mixtures of coal dust and air into a highly explosive body. As the explosion takes place, and as the carbon monoxide already produced is oxidized to carbon dioxide by the action upon it of water vapor present, and also by its direct combustion with oxygen, the hydrogen of the water vapor is set free, whilst the heated coal dust also yields certain inflammable products of distillation to the air, and partial combustion also of the coal dust gives a considerable proportion of carbon monoxide once more, and these, driven rapidly ahead of the explosion, form, with more coal dust and air, a new explosive zone, and so by waves and throbs the explosion is carried through the dust laden galleries of the mine.

Repairs to Rock Drills.

General Mining Ass'n. of Quebec—Discussion Continued on Paper by Mr. A. Sangster.

By Mr. John E. Hardman, S.B., M.E., Halifax.

I have perused Mr. Sangster's paper with much interest and have looked in the discussion which followed for some categorical statement which would show the actual cost per month (or per year) per drill for repairs, or for renewal of parts. Not finding this I propose to give some figures, which are the result of three years working of a Rand drill plant at the mines of the West Waverley Gold Co., Ltd., Waverley, N.S.

The number of drills in the plant is five, three being No. 2 L.G., and two No. 3 L.G. During the last year a 32 slugger (the equivalent of a No. 2 Little Giant) has replaced one of the No. 2 L.G.'s and I shall make reference to this substitution later.

Of this number of drills, three have been in constant use, at an average, the aim being to always have one drill of each number in the shop in perfect repair, so as to substitute it without loss of time, in case of any accident to a working drill below.

The total cost of repair parts during this period of three years ('92, '93 and '94) has been $275.05 or an average per drill per year of $30.65. But at the end of these three years there is but one drill in the lot of five that is fit for service. At a careful estimate about $18.00 would be necessary to make this drill serviceable for another year; so that to the amount of $275.85 should be added, *at the least*, the cost of four drills, say $800.00, making a total of $1075.85. To be yet more accurate we must add a portion of the cost of the fifth drill, which is serviceable for a time yet, say $150.00, making a cost of $1225.85 for five drills for three years, or $136.20 per year per drill.

In view of these figures it certainly would appear that Mr. Blue's suggestion that the manufacturers should sell the drills at "something like 25 or 50% on the cost" and then send them, after six or eight months use, to the scrap heap, is the most practical and economical from the user's standpoint. For it must not be forgotten that the above figures do not include the labor of the blacksmith or machinist who removes the broken or worn parts and fits the new ones, and cleans and oversees generally the drills of the plant; only the first or market cost of the repair pieces, and of the shop in reboring, etc., etc., are included in the figures given.

As a matter of convenience (which may also be interesting to some members of the Association), I have had calculated the cost per drill per year for each of the various renewal parts we have been required to use.

Name of Part.	Cost per Drill Per Year.	Name of Part.	Cost per Drill Per Year.
Piston packing rings	$0 55½	Slide valves	$0 22
" springs	0 13⅓	Valve seats	0 50
Ratchet	1 00	Rockers	1 44½
Pawl	0 59½	Rocker pins	0 89
Pawl springs	0 08	Throttle valves	0 72
Pawl studs	0 14	Feed screw	0 39
Rotating bars	1 22¼	Jamb nut	0 02
Rotating nuts	1 11	Feed nut	1 95
Buffer yoke	0 05½	Shells	3 88
Cylinder Buffer	0 11	Split stuffers	0 66
Chuck bolt nuts	0 22	Step clamp bolt	0 44
Chuck keys	0 33⅓	Arm clamp bolt	0 42
Chuck bushings	4 22	Hose end fittings	1 29

In this list it is seen that "chuck bushings" easily stand first, with "shells" a good second. An explanation of this is not easy; many of our chuck bushings at first were very brittle and broke easily. Since getting a better bushing the wear must be attributed largely to the sharp cutting quality of quartz dust. Mr. Geo. R. Smith's remark that the life of a drill depends largely upon the operator and also upon the rock to be drilled, will be endorsed by every drill user.

As an instance I may allude to an installation of Rand drills put into one Oldham mine some few years ago, the repairs to which have amounted to less than $10.00 per drill for the whole of that time. The difference between the cost of these repairs and those at Waverley is chiefly due to the difference in the nature of the rock encountered. It is also due in part to the fact that we work at a higher air pressure in Waverley than in Oldham, the guage underground in Waverley reading 90 lbs., while at Oldham the average pressure did not exceed 70 lbs. per square inch. The high pressure in Waverley was a necessity, as the drainage pumps of the mine are operated by compressed air.

The most effective agent in reducing the cost of repairs to drills has been the adoption of the rule of charging all repairs against the contractors or miners operating each drill. At the end of each month the repair bill is scrutinized closely by the management and items unquestionably due to wear and tear are assumed by the company; items due to carelessness or recklessness are charged to the men operating the drill.

In reference to the remarks of several gentlemen regarding the quality of oil to be used, I might say that in gold quartz mining the use of oil has almost to be prohibited, at any rate it has to be minimized, as the oil is most detrimental to subsequent amalgamation in the mills. At the suggestion of Mr Halsey, who was connected in the matter, the experiment was tried of using a compression grease cup on the drill. It was found that although lubrication of the valve was perfect, the grease failed to properly lubricate the cylinder, and after attempts to use glycerine and plumbago had also proved abortive, we were compelled to return to a light machine oil, and to use the greatest care and supervision in its use on the drill. But we have never found the wear on the cylinders to be a principal item, and in this respect cannot consider Mr. Sangster's idea of bushing as of prime importance.

Something over a year ago we substituted a 32 Slugger for one of the No. 3 Little Giant drills, hoping thereby to diminish the number of renewal parts.

Our experience with the Slugger has been most satisfactory, so much so that we have substituted two more Sluggers in place of "Little Giants." We find that the Slugger No. 32 working under our high air pressure is a more economical machine, and one that is fully as effective in hard ground, and we have also had the satisfaction of seeing our bills for new parts materially reduced. In my experience of 17 years I have never worked a more satisfactory air drill than the Rand 32 Slugger.

The Variation of Pressure in Cornish and other Pumps.*

By G. E. J. McMurtrie, A.M. Inst. C.E.

My attention has lately been drawn to a very interesting subject, viz., the variation of pressure in Cornish and other pumps.

This has led me to make a series of experiments on the Foxes Bridge Colliery pumps.

This engine was fully described in Vol. 18, No. 4, of the Institute Proceedings, and it will be sufficient here to state that it is an ordinary 56-inch Cornish Condensing Engine, with Cataract gearing governing the upstroke of the engine; and with a lower 12-inch plunger forcing 373 ft from bottom, and an upper 15 inch plunger forcing 521 ft. further to surface. The rising main is 13 inches diam. throughout.

Experiments were made just above the delivery and suction clacks of both plungers, so as to compare their action. And to make the experiments as complete as possible, the speed of the engine was in each case regulated as nearly as possible to 1, 2, 3, 4, and 5 strokes per minute, by means of the cataract. In no case was the engine handled by the driver, so that the results obtained are those regularly obtained in its working.

It should be added that each result is the average of some ten experiments.

The guage used was a duplex, with two pointers to check one another, and was kindly lent by Messrs. Harvey, of Hayle, who supplied this new pump work. The pipe connecting it to the pump work was only a few inches in length.

The following are the results (*see* also Plates 4 and 5):

Bottom Plunger.—Gauge fixed just above Suction Clack.

Statical pressure, 144 lbs. per square inch.

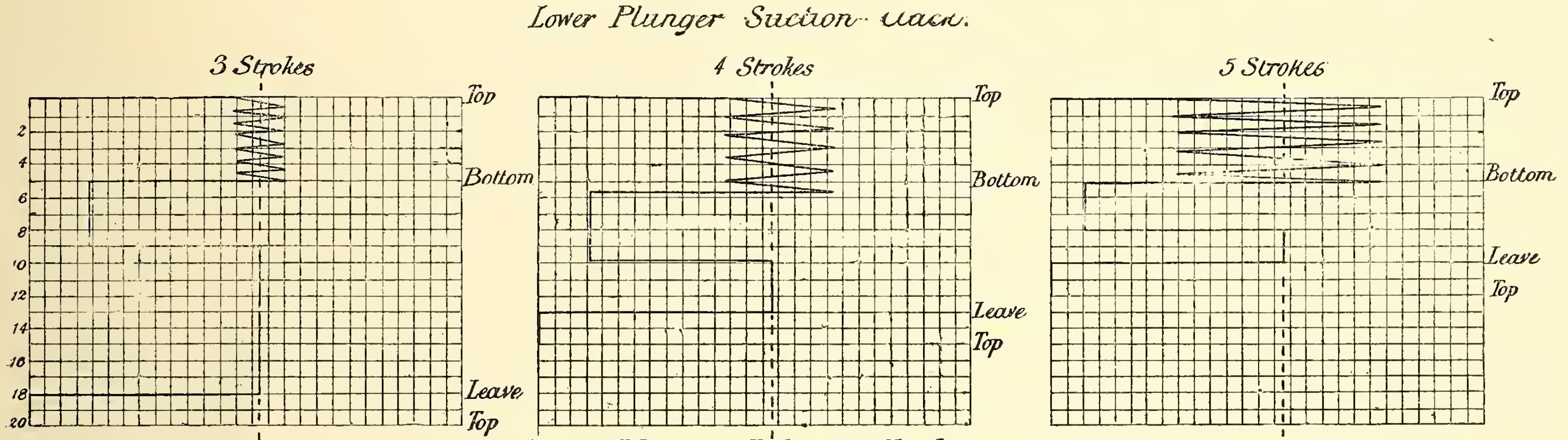
Speed of Engine in strokes p. minute	1	2	3	4	5
Time of up stroke in seconds.	2½	2	2	2	2
" down stroke "	5	6	5	5	5
Resting at bottom	50	20	13	8	5
Pressure during up stroke	zero	zero	zero	zero	zero
Duration of same in seconds	2	2	2	2	2
Vibration on Plunger reaching top	160to130	160to130	160to129	183to116	205 to 79
Duration of same in seconds	2 (?)	5	5	5½	5
Pressure on Plunger reaching bottom	50	43	38	32	22
Duration of same in seconds.	5½(?)	4	4	4	3
Returning to	144	144	144	144	144
Duration of same in seconds	48	17	9	3	2

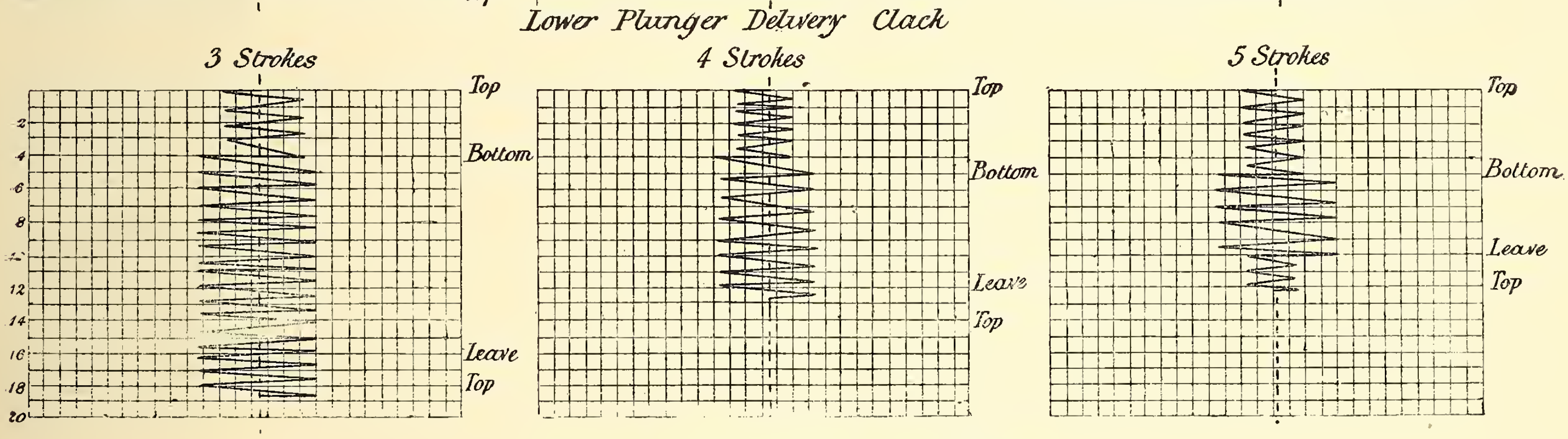
Maximum pressure on Plunger reaching top, 205 lbs., being 61 lbs., or 42·4 per cent. above statical pressure.

Minimum pressure, zero.

Range of variation, 205 lbs.

Experiments made April 26, 1894.





Variation in Pressure in Cornish and other Pumps.

Bottom Plunger—Gauge fixed just above Delivery Clack.

Statical pressure, 143 lbs. per square inch.

Speed of Engine in strokes per minute	1	2	3	4	5
Time of up stroke in seconds	2	2	2	2	2
Time of down stroke in seconds	5	5	5	5	5
Resting at bottom	54	21	11	7	5
Vibration on Plunger reach'g top	154to133	173to127	172to125	157½to124½	160to122½*
Duration of same in seconds	5	4	4	4	5
Vibration on Plunger reaching bottom	179to112½	178to110	180to107	175½to113	180 to 105
Duration of same in seconds	54	23	14½†	8½	5
Gauge returned to	143	143	143	143	143
Duration of same in seconds.	2	2	2	2	—
Vibration on Plunger leaving bottom	—	—	—	—	155 to 125
Duration of same in seconds	—	—	—	—	2

*Gauge dropped momentarily to 143 lbs. on Plunger leaving top.
†Strong vibration just before Engine reached bottom.

Maximum pressure on Plunger reaching bottom, 180 lbs., being 37 lbs., or 26 per cent. above statical pressure.

Minimum pressure, 105 lbs., being 38 lbs., or 26·6 per cent. below statical pressure.

Range of variation, 75 lbs.

Experiments made April 26, 1894.

Upper Plunger.—Gauge fixed just above Delivery Clack.

Statical pressure, 200 lbs. per square inch.

Speed of Engine in strokes per minute	1	2	3	4	5
Time of up stroke in seconds	2	2	2	2	2
" down stroke "	6	5	5	5	5
Resting at bottom	56	21	11·5	8	5
Vibration on Plunger reaching top	214to191	200to187½	210to188	217½to191	232½ to 180
Duration of same in seconds	4	4	4	4·5	4
Vibration of Plunger on reaching bottom	260to140	260to 140	260to137	259 to 135	272½ to122½
Duration of same in seconds	27	21·5	14	2	2⅔
Gauge returned to	200	200	200	200	200

Maximum pressure on Plunger reaching bottom, 272 lbs., being 72 lbs., or 36 per cent. above statical pressure.

Minimum pressure, 122 lbs., being 78 lbs., or 39 per cent., below statical pressure.

Range of variation, 123 lbs.

Experiments made April 23, 1894.

*South Wales Institute of Engineers.

Upper Plunger—Gauge fixed just above Suction Clack.

Statical pressure, Zero.

Speed of Engine in strokes per minute	1	3	4	5
Time of up stroke in seconds	2	2	2	2
Time of down stroke in seconds	4	5	5	5
Resting at bottom	59	11½	8	5¼
Pressure during up stroke	zero	zero	zero	zero
Duration of same in seconds	2⅔	2	2	2
Vibration on Plunger reachihg top	220	240	240	240*
Duration of same in seconds	3¼	3	2½	2⅓
Pressure on Plunger reaching bottom	150	140	135†	130 } in 5 sec.
Duration of same in seconds	3	4 2/7	5¼	..
Which gradually rose to	180	170	155	150 } in 5 sec.
In	8¼	8	4¼	..
Returning to	zero	zero	zero	zero
In	39	1½	1	1⅓

*On Plunger descending the gauge dropped to 200 lbs. in 1⅓ seconds.
†With a considerable vibration.

Maximum pressure on Plunger reaching top, 240 lbs.
Minimum pressure, zero.
Range of variation, 240 lbs.
Experiments made April 23, 1894.

It is by no means an easy matter to take these indications, but the results agree well, and great care was taken in making them.

The *modus operandi* was first to regulate the strokes of the engine by means of the cataract. Next, to time the upstroke, downstroke, and time the engine rested at bottom; there being no appreciable stop at top.

Finally the pressures were taken in the shaft by myself and two men; one calling out the position of the plunger, the second reading the gauge, and the third timing the period of the vibrations.

At the higher strokes two men were required to read the gauge, and the times were noted after. As the engine was going at a regular speed this would not however matter.

Messrs. Harvey, to whom a copy of these experiments was forwarded, have raised an interesting point. They argue "that the variations in pressure shown by the gauge at the higher speeds is greater than that due to the actual pressure. The increase on the pole reaching the bottom being 30 to 40 per cent. above that due to the head of water, the weight of the rods, etc., would not be able to force the pole down against the pressure, and the addition owing to friction of rods, packing, etc." They have "noticed in practice, that if pressure is brought suddenly on to a gauge, the index vibrates beyond the pressure actually applied, this being due to the elasticity of the spring." And this, they urge, "has happened in these experiments, especially as the mean of the vibrations gives about the pressure to be expected from the head of water."

Their impression is "that the friction of the water, etc., would increase the pressure by from 5 to 7 per cent. above that due to head, when the pole is working at 5 to 6 strokes per minute."

They "instance a case of a 90-inch engine, the load on the piston of which was 12 per cent. more than the area of the poles multiplied by the pressure due to head of water, this 12 per cent. being accounted for by friction of piston rods, pole packing, friction of water in rising main, &c.".

In regard to Messrs. Harvey's contention, that with such an increase in pressure the engine would not be powerful enough to do the work, it must be remembered that these great increases both at top and bottom occur just when the rods come to rest, and consequently do not increase the work to be done by the engine, and the consequent consumption of fuel.

To reduce the vibration of the spring they also suggested taking these experiments with the gauge partly closed, and stated that they found if the cock leading to the gauge be nearly closed the gauge moved much more steadily.

No doubt if the cock leading to the gauge be partly or nearly closed, the vibrations will be less, but if water be driven through such a small opening, will not this greatly increase the friction, will the vibrations be equally quickly conveyed, and will the results obtained be accurate?

In order to test this, the following additional experiments were made with the gauge approximately half open, above the suction and delivery clacks of the bottom plunger, the engine in each case being driven at 4 and 5 strokes per minute.

Bottom Plunger.—Gauge fixed just above Delivery Clack.

Statical pressure, 142 lbs. per square inch.

Speed of Engine in strokes per minute	4	5
Time of up stroke in seconds	2	2
" down stroke "	5	5
Resting at bottom	8	4
Vibration on Plunger reaching top	151 to 129	166 to 121
Duration of same in seconds	5	5
Vibration on Plunger reaching bottom	174 to 110	174 to 109
Duration of same in seconds	4	3½
Gauge returned to	142	142
Duration of same in seconds	4	1
Vibration on Plunger leaving bottom	—	150 to 130
Duration of same in seconds	—	2

Experiments made May 8, 1894.

Maximum pressure on Plunger leaving bottom, 174 lbs., being 32 lbs., or 22·5 per cent., above the statical pressure.

Minimum pressure, 109 lbs., being 33 lbs., or 23·2 per cent., below the statical pressure.

Range of variation, 65 lbs.

Bottom Plunger—Gauge fixed just above Suction Clack.

Statical pressure, 144 lbs. per Square Inch.

Speed of Engine in strokes per minute	4	5
Time of up stroke in seconds	2	2
Time of down stroke in seconds	5	5
Resting at bottom	7·5	4·5
Pressure during up stroke	zero	zero
Duration of same in seconds	2	2
Vibration of Plunger reaching top	160 to 127	172 to 112
Duration of same in seconds	5	5
Pressure on Plunger reaching bottom	48	26
Duration of same in seconds	4	3
Returning to	144	144
Duration of same in seconds	5	2

Maximum pressure on Plunger reaching top, 172 lbs., being 28 lbs., or 19·4 per cent., above the statical pressure.
Minimum pressure recorded, zero.
Range of variation, 172 lbs.
Experiments made May 8, 1894.

These experiments agree with those previously taken with the cock fully open, except that the vibrations are not quite so great.

Next, the gauge was fixed above the delivery clack of the lower plunger, and with the engine worked at 5 strokes the following was found:—

With the cock slightly open the gauge stood at zero.
With the cock one-quarter open the gauge stood at 70 lbs.
With the cock one-third open the gauge showed slight vibrations.
With the cock half open the gauge showed considerable vibrations.
The statical pressures were next tested above the delivery clack.
When the gauge was wide open as before it registered 142 lbs.
When the gauge was half open it registered 65 lbs., and this pressure decreased as the cock was closed.

These last experiments, on the dynamical and statical pressures, appear to me to prove conclusively that such experiments, to be accurate, must be made with the gauge cock fully open.

The following are the probable reasons for the great variations of pressure on the pump work:—

Taking first the action of the gauge, when placed above the delivery valves of both plungers, we find on the plunger reaching the top, there is a great vibration, due doubtless to the plunger travelling faster than the water on leaving the bottom; on the plunger stopping at top the water reaches it, and at the same time the plunger drops 1½ inch or so, opening the delivery clack, and throwing the full weight of water suddenly on the plunger. On the plunger reaching the bottom the vibration is considerably greater, possibly owing to the water not escaping as quickly as it might, and consequently there is additional pressure put on it. This is in part borne out by the fact that the vibration with the bottom plunger, which is a 12-inch pumping into a 13-inch rising main, is less than with the top plunger, which is a 15-inch pumping into a 13-inch rising main, even allowing for the difference in height of the respective rising mains. Or else on the plunger coming to rest the rising water is checked, and then falls back on the delivery clack, closing it. Possibly it may be a combination of the two.

At a speed of five strokes a considerable vibration is also shown by the gauge, on the lower plunger leaving the bottom, and on checking the experiment this was found to be correct. Probably this was due to this delivery clack being not tight at the time, but it is difficult to see why this occurs only at this speed.

When the gauge is placed between the clacks, the results obtained from both plungers are very similar, except that the gauge returns to zero when the top plunger rests at the bottom, showing that the delivery clack is tight; while the gauge attached above the bottom plunger suction clack registers the statical pressure when the plunger rests at bottom, showing that there is leakage here. During the up stroke the gauge registers zero, as the plunger outstrips the water. On reaching the top there is a considerable vibration, owing to the rising water reaching it, and the plunger dropping back and thus opening the delivery clack, which suddenly throws the weight of water in the rising main on the gauge.

The drop in pressure on the plunger reaching the bottom, is probably in part, if not wholly, due to the rushing water leaving the now standing plunger, causing a reduced pressure.

In the case of the upper plunger there is a slight increase in pressure before the gauge rests at zero. This may be due to the clack, which is an ordinary one with a relief clack on top. The first pressure is shown on the plunger coming to rest, and the water leaving it, so to speak, the main clack then closes, and the pressure rises as the velocity of the water drops. Next the relief clack closes, and the pressure drops to zero. The absence of this slight rise in connection with the bottom plunger is probably due to the gradual rise to the statical pressure hiding it; this rise being due to leakage of the delivery clack.

The drop in pressure shown by the bottom plunger is much greater than that shown by the upper plunger, and is possibly due to a 15-inch plunger pumping into a 13-inch main in the latter case, and in the former case a 12-inch plunger pumping into a 13-inch main, the freer vent thus given the water producing the lower pressure.

It will be well here to say, that Messrs. Harvey state the increase in pressure caused by a large plunger pumping into a small rising main is very small, except in very extreme cases. They instance the case of an 18-inch pole with 8-foot stroke, making 14 strokes per minute, pumping into a 12-inch main, the increase in pressure due to the small area of the delivery being but 3 per cent. beyond that due to the head.

Experiments similar to these described have been made by several. It may be of interest to refer to some.

Mr. Emerson Bainbridge experimented on an 84-inch beam engine, with two 26-inch lifting sets at one end of the beam, and an 18-inch and 16-inch lifting set at the other end.

Mr. F. N. Hall, on a Cornish engine erected at the Settlingstones Lead Mine in 1868. The engine had a 60-inch cylinder, and attached to the outer end of the beam were a 7-inch set lifting to 12 fathoms, two 13⅜-inch sets lifting a further 17 fathoms, and finally an 18-inch plunger set forcing a further 37 fathoms.

Both of these papers are in Vol. 21 of the North of England Engineers' Proceedings.

The Foxes Bridge experiments can be compared only with those on the Settlingstones forcing set. With these they agree well, except that the vibration at the bottom of the stroke is greater than that at the top of the stroke, whereas the Settlingstones pumps showed the reverse.

The Settlingstones experiments also showed the dynamic pressure on the bucket to exceed the dynamic pressure on the plunger in the proportion of 1·7 to 1·3 times the statical pressure of the column, which gives forcing sets a decided advantage over lifting sets if this be reliable.

The remedy suggested by Mr. Hall for these excessive pressures is the admission of a small quantity of air at each stroke, pumps connected with fast-working engines on board ship being said to do this. This was further emphasized by other speakers.

Is this ever done in connection with Cornish engines? A compound rotary engine, erected by Messrs. Simpson at Throckley Colliery a few years ago, an air vessel was placed at the pit bottom. In connection with large horizontal pumps placed underground, forcing from the bottom to the top of the pit, this is also generally done. If it is found useful in these cases, it seems reasonable to expect that it would be useful to the Cornish engine.

In the course of the discussion on Mr. Hall's paper, Mr. J. B. Simpson said he had obtained an increase of pressure of 50 per cent. in plunger pumps over that due to the column.

The fact that a pump delivers water long after the stroke is completed was referred to. In our case this continues till the commencement of the next stroke, though it is a decreasing quantity. This *vis viva* may explain the length of vibration of the spring.

Mr. Bulman, in Vol. 3, page 107, of the British Mining Students' Proceedings, describes some similar experiments made by Mr. Wight, the engineer, on the Dinnington Colliery pumps. The engine was a 66-inch condensing beam engine, with 10-foot stroke in pit, and steam on the piston on both up and down strokes. It has an 18-inch set lifting the bottom 72 yards, and an 18-inch set forcing 56 yards further attached to the one end of the beam; and a 20-inch set lifting a further 72 yards at the other end.

These experiments agree with the Foxes Bridge ones, in showing a greater vibration at the bottom of the stroke than the top, above the delivery clack, and thus differ from those made at Settlingstones. Above the suction clack, however, at the bottom of the stroke, the pressure appears to rise largely before the fall in pressure comes.

Mr. Wight suggested that the area of the pumps above the working barrels be increased, so as to check the velocity of the rising water above the clacks, and thus the fall of water with its consequent shock would be reduced.

Mr. Bulman also gives the following (Vol. 16, page 88): —

At Gosforth Colliery there is a pair of Tangye's special double-acting pumps, with 7-inch rams, 32-inch steam cylinders, and 6-foot stroke, forcing 1,080 feet. At 10 strokes per minute the gauge showed a vibration of 450 to 550 lbs., while the statical pressure is 468 lbs. A clack was fixed between the gauge and the rising main, and the low pressure was got on this closing, and the high when the head of water was encountered.

At Springwell Colliery there is a pair of Evans' Cornish duplex engines, with 24-inch cylinders, 3-foot stroke, and 8½ double-acting rams, forcing water 780 feet. The statical pressure of this head is 338 lbs. With the two pumps working the pressure varies from 300 to 370 lbs., with one pump only from 250 to 450. At Byer Moor Colliery there is a pair of 6-inch double-acting pumps, with 4-foot stroke and 20-inch cylinders. The statical pressure is 220 lbs.

Until an air vessel was added, with an arrangement for charging the air vessel at the pressure due to the head of water, the pressure varied from 180 to 270 lbs. With the air vessel, there is little or no vibration. Mr. Bulman advocates the addition of air vessels to direct-acting engines, to reduce the strains on the pump work, and considers that the variation of pressure depends largely on the efficiency of the valves.

Other experiments by Mr. Melly (Vol. 8, page 40, of the British Students), on a Cornish engine with 17-inch ram forcing 144 yards, show similar results above the delivery clack to those obtained by myself.

Diagrams of the Foxes Bridge experiments are shown on Plates 4 and 5 with the engine going 3, 4, and 5 strokes.

The vertical divisions represent pressures of 10 lbs., the horizontal division intervals of 1 second.

The times when the plunger reached the top and bottom, and when it left the bottom, are also given.

There was no rest at the top of the stroke.

The zigzag line represents the pressures registered by the gauge, the dotted line the statical pressure.

THE GENERAL MINING ASSOCIATION OF THE PROVINCE OF QUEBEC. ORGANISED 1891.

GENERAL MINING ASSOCIATION OF QUEBEC.

Proceedings of Fifth Annual Meeting—*Continued.*

The concluding session of the Association was held in the New Club Room, Windsor Hotel, Montreal, on Friday afternoon at two o'clock, Mr. John Blue, C. and M.E., President, in the chair.

THE IMPORTATION OF MINING MACHINERY.

THE SECRETARY again called attention to differences of interpretation by collectors of the law respecting the free admission of mining machinery. In the Province of Quebec, for instance, he was informed by one of their members that silvered copper plates for a gold mill had been held for duty, notwithstanding that for a number of years these plates bad been admitted free in the Province of Nova Scotia. The Ontario Government imported recently two Sullivan prospecting drills from Chicago and the duty had been charged, notwithstanding a provision of the law which specially provided that diamond drills be admitted free. The Cumberland Railway and Coal Co. had brought in, for use at their Springhill collieries, a very heavy and specially designed colliery pump, from Jeansville, Pa., of a class or kind not manufactured in Canada, but the duty was collected under protest. The New Glasgow Iron, Coal and Railway Co. had also been compelled to pay under protest duty on their coal washing plant, machinery not manufactured in the country. Some difference of opinion existed in the Department of Customs respecting the meaning of the Act, it being claimed that in this instance a coal washing plant was not, in the strict sense of the word, mining machinery, but he understood that a ruling had been given by the Department of Justice which admitted all machinery and appliances for mining and treating ores and minerals to be within the jurisdiction of the Act. Some action should be taken to bring the matter again to the attention of the Department, and he would move that the President and Secretary, with Messrs. H. A. Budden, H. Drummond, J. Burley Smith, S. L. Spafford, R. T. Hopper, J. J. Penhale, Capt. Adams and S. P. Franchot be a deputation to interview the Minister of Trade and Commerce and the Controller of Customs.

MR. R. T. HOPPER said his company had brought in a crushing plant not manufactured in the country; they had to pay duty, and it had never been refunded. He seconded Mr. Bell's resolution.

MR. PENHALE—The only list in the hands of the collectors was one furnished by the Jenckes' Machine Co. of Sherbrooke, which embraced everything under the sun.

CAPT. ADAMS moved that the Committee appointed by the last motion be requested to bring before the Government the question of admitting all mining machinery free into the Province of British Columbia for a limited period. In making the motion he pointed out that the present law had been framed before mining in British Columbia had assumed its present importance, and consequently so far as that province was concerned the law was practically a dead letter. Mine owners could not imprort their machinery from the Province of Quebec, and they had to import it from the United States. Mining was largely conducted by American capital and American machinery, and if it were not for the present law more capital would be forthcoming from Americans for mining purposes. Capt. Adams' motion was seconded and agreed to.

THE QUEBEC MEETING.

THE SECRETARY moved that the next meeting of the Association be held in the City of Quebec and that the following be a Committee of Arrangements:— Hon. George Irvine, Q.C., Mr. James King, M.P.P., Mr. C. H. Carriere, and Mr. J. T. Dyer.

The motion was agreed to.

A vote of thanks to the contributors of papers and to the chairman terminated the proceedings.

The Geological Survey and its Operations.

By DR. R. W ELLS, OTTAWA.

(Continued from January Issue.)

In British Columbia the work of the last twenty years has made us very familiar with the immense value of the coal fields of Vancouver, and with the inexhaustible forests which are found, not only on that island, but at many points on the mainland. The mapping of many of the gold fields of the interior has also been done, and the structure of the rock formations in the Rocky Mountain chain has been carefully worked out. The great mineral deposits of the Kootenay district have been thoroughly examined and much valuable information bearing upon their distribution and origin has been obtained. Further to the north the country traversed by the branches of the Peace River has been examined and the probabilities for successful mining investigated, while we have now ascertained very carefully the value of the coal area in Queen Charlotte Islands, and the distribution of the gold-bearing rocks and other formations in the great mountain area, lying to the east of the Alaskan boundary.

But the study of the rock formations and their associated mineral wealth does not by any means limit the work of the Geological Survey of Canada. In its operations are included the study of its forma and flora. In the museum at Ottawa, stored away in cases and high presses can be found one of the largest and most complete collections of plants illustrative of the history of all parts of our Dominion possible to be obtained. Much of the work of this branch of the department is not seen by the ordinary visitor, since, unlike rocks, or masses of ore, dried plants are perishable things, and must not be exposed to light and open air. They must be carefully laid away and precautions taken to guard against the ravages of insects and other enemies of the botanist's handiwork. In these cases more than 100,000 specimens are stored, illustrating the distribution of the flora of the Dominion from the shores of Anticosti to the green valleys of Vancouver. The flora of the Peace River district, of the Mackenzie River, and the famous barren grounds of the great plains and of the Rocky Mountain slopes, in the west; of the shores and islands of the Atlantic coast in the east, as well as of the country about the great inland lakes, and the interior of distant Labrador, is thus rendered available for study to anyone interested in the botany of our country; and to the botanists and collectors of the Survey great credit and praise are due for the careful way in which this branch of the Survey's work has been carried on. Equally inconspicuous also with the botanical specimens are the magnificent collections illustrative of the insect life of the country, and probably most of those who wander through the corridors of the museum are unaware that such beautiful illustrations of this branch of scientific work are there stored. The ornithology, and to a certain extent also, the zoology of the Dominion are well shown by means of a good collection of the principal birds and mammals, while the various species of land and marine shells are also exhibited. Though in but few of these are the collections by any means exhaustive, sufficient has been done to shew that the comparatively newer branches of natural history have not only not been exhausted, but that the results already obtained are of very considerable importance.

The division of ethnology has also received considerable attention. Extensive collections illustrating the manners, customs and institutions of the various Indian tribes which now inhabit our country have been made, as well as large quantities of the remains and relics of former races. The branches of paleontology, mineralogy and lithology, so intimately connected with the geological work, have been maintained at their usual high grade of efficiency, though the opening of the north-west territories has introduced a new feature into the study of Canadian paleontology by the accession of great collections of fossils from the cretaceous and other closely associated formations found in that area, as well as from the older formations of the Rocky Mountain complex. The result of the fifty years collecting in this branch of the Survey's work has been to gather together one of the finest and most comprehensive collections illustrative of the life of past ages in the earth's history that can anywhere be found, a collection of such value to the scientific world, that if by chance it should be destroyed, its loss would be regarded as a great calamity by everyone interested in science the world over.

Of the internal economy of the Survey we have as yet spoken in but general terms. The collecting of facts relative to the structure and the making of sur veys in the field would not possess one-tenth of their real value were no provision made by which these surveys and facts could be presented in compact and visible shape to the general as well as the scientific public. Hence the necessity for a topographical corps, whereby not only the work of the field staff can be arranged in map form for publication, but connecting surveys can be made to render these more intelligible. Then there is the careful arrangement of the museum, by which means everything deemed worthy of exhibit can be so displayed as to shew to the best possible advantage the relations between the rock structure and the contained fossils where such exist, or the minerals or ores which may be therein contained; so that anyone in quest of information can most readily obtain such to the fullest possible extent and with the least possible delay. The library division also is one of importance, in which the working scientist can find the most recent helps to enable him the better to profit by the researches of his brethren in other but similar fields, and so become the better fitted to work out the problems he may himself encounter; and here it may be said that the library of the Geological Survey is probably the most complete in scientific literature of any of the libraries in the Dominion, and in as far as practicable is kept well abreast of the time as regards the current literature of the subjects concerned.

The financial management of such an institution is also a most important item in its general scheme of successful work, and the proper disposition of the funds, by which the necessities of the several widely scattered parties can be best met, calls for a wise discrimination of the needs of each and the expense peculiar to each locality to be explored; the prime object being the most judicious expenditure of the money at the disposal of the department, consistent with the highest and most satisfactory results obtainable.

I trust in the very imperfect description of the work done by the Geological Survey department, I have shewn you that in the old building on Sussex street, many kinds of work, of great importance to the nation, are being carried on. The structure and contained wealth of the rock masses from the Laurentian or fundamental crust of the earth to the most recent formation of drift sand, gravel and peat, are being systematically studied and their actual value, in so far as this is possible, is ascertained. The importance of each system, as a source of mineral supply, is carefully weighed, and the mode of occurrence and probable extent and value of each element of economic importance, sought out when practicable, to some extent in the field, and in more detail in the labratory. Not only are the analyses of the rocks and of the contained ores there conducted, and their probable value from many localities carefully proved, but the chemical composition of the mineral waters from the various provinces of the Dominion is carefully ascertained, and their probable beneficial effects noted. Many of these have already proved to be large and important sources of revenue to the localities in which they occur, as at St. Leon, Caledonia, St. Catherines and other points. Much of this work, though presented annually in published volumes, fails to reach the general public, being by some curious process of reasoning apparently regarded as of more importance to scientific bodies and institutions of learning abroad than to those who are most directly interested in the development of the country's mineral wealth, a condition of things which doubtless to a large extent accounts for the oft repeated question "What is the work of the Geological Survey?" In the present arrangement of publication, however, much greater facilities now exist for obtaining desired information in any particular area.

It may, perhaps, be allowable for the sake of illustrating some of the points just presented to compare the personnel and the financial outlay of the Canadian Survey with those of our great neighbor to the south, where the area of surface to be covered by its operations is not very different from our own. In the United States, however, owing to certain conditions of climate and other causes, field parties are enabled to spend a very much longer period in exploration than is possible in this country. Thus we find by comparison of the figures of the two surveys for the year 1887-88, that the expenditure of the American Survey for that year, exclusive of publication, was about half a million dollars; that of the Canadian Survey for the same date, including publication and all expenses of management, was about a fifth of that amount. A portion of this sum amounting to about $20,000 only was divided among sixteen parties whose operations extended from Eastern Nova Scotia to Alaska, and included surveys in all the provinces, with special examinations of the country east of Alaska and the MacKenzie River Basin, Hudson and James' Bays and Lake Winnipeg and vicinity. In numbers the staff of exploration comprised in all, including assistants, thirty-five persons. In addition work was carried on in the branches of paleontology, botany, chemistry, etc., the results of that year being comprised in twelve scientific reports, besides that of the Director, which were published in two volumes of 1,364 pages, in addition to the bulletins on paleontology and botany. The American Survey during the same year employed in the geographical branch alone, eighty-five assistants, in addition to the chiefs of divisions, of whom there were fifteen in connection with the outside or geological work proper, and twelve for the associated branches, among whom were many of the leading professors in the different Universities, men most distinguished in their special lines of work. With such a command of men and money, magnificent results may be confidently looked for, yet in the published volume for the year mentioned there are only four scientific reports besides that of the Director, with twenty-four administrative reports, which correspond with the summary reports of the Canadian Survey, and describe the season's operations only as carried on by the different parties, the whole being contained in a magnificently illustrated and printed volume of 710 pages. In addition, as in the Canadian Survey, bulletins containing special reports on the work done in the various associated subjects were also published. Comparing results then, in so far as these can be ascertained, it is evident that the Canadian Survey has continued to maintain the high standard of efficiency which it has enjoyed from its very commencement and is giving full value for the amount of money expended thereon. The excellent reputation which it has borne, both at home and abroad, is due probably, first of all, to the reputation of its founder, the late Sir Wm. Logan, and secondly to the fact that the great majority of its staff have labored to the utmost with hearts filled with a love for the subject and with a desire to achieve great and lasting results; and while it would be folly to assert that the work of the Canadian Survey, or of any similar institution has always been free from mistakes, since that would imply a degree of infallibility and accurate scientific knowledge, not yet enjoyed by mortals, it will, I think, be admitted by anyone conversant with its methods of operations that the attainment of truth in regard to the geological questions presented has ever been the chief aim of those associated in the work.

MR. B. T. A. BELL—I see from this evening's papers the announcement of Dr. Selwyn's superannuation and the appointment of Dr. George Dawson as his successor to the Directorship of the Survey. It would be fitting in the presence of so many who are interested in the development of the resources of the country were we to express our appreciation of the labors of Dr. Selwyn in connection with this important department of the public service. (Hear, hear.) Dr. Selwyn's worth is widely known and honoured in the scientific world and while he may not have realized in the operations of the Survey, the ideals which mining men had formed, it was unquestionable that his labors had been beneficial in greatly extending the knowledge of the resources of the Dominion. It was hoped that the new Director, Dr. Dawson, who was not only the son of an eminent Canadian, but was himself an eminent Canadian, would give particular attention to the equipment of the Mining Bureau, and that more attention would be paid to the commercial features of our mining industries than had been the case in the past. In the present youthful condition of the country we could not afford expensive explorations of the "Barren Lands" and other sections too remote to be economically available for many years to come, when there was urgent need of information that would be economically available respecting mineral discoveries and mining industries nearer at home. It was the duty of the Bureau when new discoveries were made, such as the chromic iron deposits of the Eastern Townships or the gold fields of Rainy River or Lake of the Woods, to immediately investigate and report the fullest possible information to the public. There was also reasonable ground for objection to the great delay that ensued between the preparation of the reports of the officers of the Survey and their publication.

MR. E. D. INGALL agreed with Mr. Bell that where any new discovery of importance was made or reported, the Bureau should send an officer at once, no matter at what time of the year, so as to get reliable and carefully collected information at the very start of the movement. Last year he had asked for an appropriation for obtaining information respecting the gold deposits of the Rainy Lake, Madoc, Chaudiere and other districts, but for reasons which he need not mention, no money was available.

MR. B. T. A. BELL—There was money enough to send Mr. Tyrell into the Barren Lands.

MR. INGALL said he felt strongly that if they could have a definite sum per year for the work, and be expected to keep within it, and be allowed to manage the the thing as he had indicated, they could do just what was required in that way. The future, perhaps, would see that. In conclusion he referred to the remarks which had been made on the previous day during his absence about the unreliability of some of the statistics sent out by the Mining Bureau, and he showed that it was almost impossible to obtain correct figures in regard to the outputs from many of the mines.

ONTARIO MINING INSTITUTE.

The Papers Contributed at January Meeting—Formal Opening of the Mining Laboratory—Members Dined by the Governors of Queens.

The Institute adjourned on Friday morning, 4th January, having held four successive sessions. In the afternoon the members were present at the formal opening of the Mining Laboratory, the first of its kind in Canada, and witnessed the operations of the plant which includes a small steam stamp mill, Frue vanners and other appliances for the reduction of ores and minerals. In the evening they were entertained to dinner in the Frontenac Hotel by the Governors of Queens, the Mayor of Kingston presiding. There was a large company present, including a number of members of the Ontario Legislature and House of Commons. A number of toasts were given and the proceedings were thoroughly enjoyable.

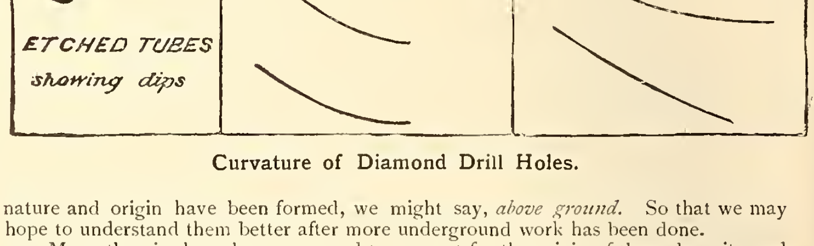
The Glendower Iron Deposit.

By W. G. MILLER, M.A., Kingston.

It was thought that a few notes on the Glendower iron deposit might be of interest to the members of the Institute, as it is the first property on which the new Government diamond drill has been put to work; and moreover, the deposit, in itself, has some features which are worthy of study.

The Glendower mine is situated in the township of Bedford, in the county of Frontenac, four miles east of Bedford station on the Kingston and Pembroke Railway, with which it is connected by a switch.

Much has been written on Ontario iron deposits by Logan, Hunt, Harrington and others. Our iron deposits have probably been studied in as great detail as have any of our economic deposits. Since, however, so few of them have been worked out or, in other words, have had their ore exhausted, most of the theories concerning their nature and origin have been formed, we might say, *above ground*. So that we may hope to understand them better after more underground work has been done.



Curvature of Diamond Drill Holes.

Many theories have been proposed to account for the origin of these deposits, and as the deposit with which we have to deal consists of magnetic iron ore, I shall, with your permission, give a short review of the chief theories which have been suggested to account for deposits of this nature, although I am aware that most of you are well acquainted with them. Afterwards I shall give a short description of the Glendower deposit, and we will try to determine which of these theories is the most applicable to it.

The chief theories, then, as to the origin of magnetite deposits are:

1st. The theory which received the support of Hutton about one hundred years ago.

Hutton believed that the iron ores which we now find among metamorphic rocks were of igneous origin, *i. e.*, that the ore had been emptied into crevices or fissures in the rocks in the molten state. His theory has now become practically obsolete as regards most iron deposits, and the tendency of opinion, at the present time, is towards the chemico-sedimentary theories. It is, however, believed by some that our titaniferous iron ores have had an igneous origin.

2nd. Another theory closely connected with that of Hutton is that in which it is supposed that iron ores have originated, for the most part, as the excessive basic portions of igneous rocks. There are such occurrences, in Greenland and elsewhere, although seldom, if ever, pure enough or abundant enough to be worked.

3rd. It has been held that many of these deposits have originated as beech sands. This theory was proposed by a Canadian, Dr. Harrington, of Montreal, in 1873, and it has since received the support of many eminent geologists.

4th. In somewhat the same way as under the last example we find magnetic sands concentrated as river bars and collected together in lake expanses or still bodies of water along rivers. Hence it has been held that deposits, which we now find among metamorphic rocks, have originated in this way.

5th. As replaced limestone beds—in which it is supposed that the iron may have replaced calcium carbonate or have existed in the form of siderite, and have been finally metamorphosed into magnetite.

6th. As submarine chemical precipitates, a theory which has been proposed by the Winchells for some of the iron ores—magnetite and hæmatite—of Minnesota. The igneous rocks associated with these ores lead to the conclusion that the enclosing rocks have been formed by submarine volcanoes. Deposits of iron and silica, which are interbedded, are thought to have originated from the heated, overlying water. During last summer, however, Spurr has shown that these ores originated from the solution or leaching out of the iron in beds of green sand or glauconite.

7th. As metamorphosed limonite beds. This theory has met with quite general acceptance, and it is believed by some observers that many of the iron deposits in this vicinity have originated in this way. The limestone and gneisses or schists which form the country rock are believed to represent sedimentary material which was laid down contemporaneously with the limonite.

8th. There is the method of formation of deposits by segregation or as segregated veins. This theory is viewed with favor by many reliable observers. By this method the iron oxide is conceived to concentrate from a state of dissemination in the walls, by slow secretion in solution, to form the ore bodies along certain favorable beds. "The nature of the action is well illustrated on a small scale by the well known disks of pyrites and calcite that form in clays and shales." This theory cannot of course be applied to magnetite deposits in general, but it is probably true in certain cases. Where it applies we should expect to find hornblende and other ferruginous minerals in association with the ore, since it would be only from the more basic rocks that the iron would be leached out, and it is also likely that the ore would be fairly well crystallized.

Many deposits are, of course, commonly spoken of as veins, although they are quite different in structure.

Besides the theories which I have mentioned, there are some ten or twelve others which have been proposed, some of which seem to be applicable in certain cases, but they are of less general interest.

It is difficult to say which of these theories can be applied to the Glendower ore body. This deposit lies in metamorphic rocks which have a strike about N. E. and S. W. and dip at an angle of over 80°, the rocks on the upper side of the deposit being crystalline limestone, while that on the lower has been described as hornblende schist. The ore itself is a coarse magnetite, and in places is well crystallized and exhibits a well defined parting or cleavage. Mixed with the ore there is considerable hornblende in large pieces. The deposit can be traced for over half a mile and, where the ore was mined, it has a breadth of from twenty to forty feet. It was worked to a depth of about one hundred and eighty feet, and a curious feature of the ore is that down for some distance from the surface of the ground it is quite free from sulphur, but after reaching a certain depth it was found to contain a considerable percentage of this impurity. The object of drilling at the present time was to test the deposit at a greater depth and see if the ore again became free from it. It is said that the shaft was sunk to a depth of one hundred and twenty or one hundred and thirty feet before the sulphuretted ore was met with.

It is claimed that in a former boring, made some years ago, the ore was found to become free from sulphur at a greater depth, and this raises an interesting question as to how the one part of the ore contains sulphur, while the mineral both above and below the sulphuretted band is comparatively free from it.

Having now briefly described the deposit, let us see if any of the theories of origin which I have mentioned will satisfactorily account for the character which it possesses.

Hutton's theory, or that which considers the ore to have been formed as a dyke, certainly cannot be applied to it, as the rocks on the sides of the deposit show no evidence of metamorphic effects, which would have been brought about had the molten mass been protruded between them.

There is no evidence that the ore is the more basic part of an igneous mass of rock.

Certain features of the deposit also preclude the idea that it has originated as beech sands or as river bars.

The deposit shows no characters which would lead us to suppose that it had originated as a submarine deposit.

The magnetite may have been produced through the metamorphism of limonite beds, although the form which the layer of sulphuretted ore takes in the deposit does not seem to point to this mode of origin. The sulphur layer is in a direction transverse to the dip of the deposit, while if the deposit had originated from the alteration of limonite, we would expect this layer to lie in the direction of the dip.

I have not met with any description of bodies of ore of this nature which contain sulphuretted bands in this form. An interesting paper is, however, to be found in the Transactions of the American Institute of Mining Engineers, Vol. XVII., by D. H. Browne, on the "Distribution of Phosphorous at the Luddington Mine." In this paper the author shows that the bands of bessemer and non-bessemer ore alternate and that they lie in the direction of the dip of the rocks.

From some characters of the hornblende rock on the lower side of the Glendower deposit, it seems possible that the ore may have been derived from this rock by a process of leaching or segregation in solution. In grinding down a thin section of the rock for the microscope I found it impossible to get a perfectly smooth and polished surface. The surface was filled with little pits or cavities as if some component of the rock had been dissolved out. Another character which makes it appear as if the iron may have been dissolved out of it is the comparative absence of oxides of this metal scattered through it, although we should expect these to be present, as they are universally found in rocks which are as basic as this one. The components of the rock are essentially hornblende and quartz, with a considerable amount of calcite. Large pieces of hornblende are found scattered through the ore, a fact which seems to point to the presence of hornblende in the source from which the iron was derived. The presence of so much calcite in the section shows that this component has been derived from some source outside of the rock itself and has replaced other constituents.

The ore, if we accept the view that it has been formed by segregation in solution, was formed in a line of weakness between the limestone on one side and the hornblende rock on the other and the iron was dissolved out of the latter by water, more or less heated, percolating through it. Along the line of weakness there would be more chance for the matter carried in solution to become oxidized and the result would be more chance for the matter carried in solution to become oxidized and the result would be that the iron which had been dissolved out and put into solution by carbonic acid or other acids or alkalis, to become oxidized and precipitated in the opening and take the place, to a certain extent, of the calcium carbonate which would be dissolved in its place. This latter material would be carried through by the percolating water and deposited, on the solution becoming concentrated, in the adjoining rocks, where there was little or no oxidation taking place. Thus it is that we find the hornblende rock filled with granules of this secondary calcite.

It seems to me, taking all the character of the ore body into consideration, that the magnetite has originated by this process of segregation from the adjoining rock, although the question needs more careful study than I have been able to give it. This theory will account for the position of the sulphuretted band. A microscopic examination of the rocks on either side of the deposit would, I believe, in connection with the other characters of the deposit, solve the problem effectually.

It has been held by most authorities that the magnetite deposits in our Archæan rocks have had a sedimentary origin and have been formed at the same time as the metamorphic rocks which enclose them. J. D. Dana has summed up the opinion of these authorities in the following words: "Geologists who have studied the widest range of Archæan iron regions—believing that they are alike in mode of origin—have reached the general conclusion that the ore and schists of all are conformable in bedding, and hence they are metamorphic sedimentary deposits."

However, we have a means now, in the petrographical microscope, of examining into these questions more deeply than our predecessors, and it is likely that more light will be thrown on the problem. The Winchells, as late as 1890, claimed, as I mentioned, that some of the iron ores of Minnesota had originated as submarine precipitate, but Spurr, on making a microscopic examination of the ore and their enclosing rocks, during last summer, proved that the ore has been formed by a leaching out of the iron from beds of glauconite.

Since it is likely that many owners of mining locations in Ontario will make use of the diomond drill, which has been so liberally placed at their service by the Government, to test their properties, it may be well to mention an important paper, on diamond drilling, which is published in the Proceedings of the Lake Superior Institute of Mining Engineers, for 1893, by J. Parke Channing. Most people seem to think that diamond drill holes must be straight, but this writer, from careful experiment and observation, has proved that in many cases they have a considerable curvature and that the direction which the drill tends to take is towards the horizontal. Mr. Channing has, as yet, not been able to determine whether there is a side curvature as well as the upward one. His paper is well worthy a careful perusal by anyone interested in drilling, and knowing the results which he has arrived at, much trouble and uncertainty will often be saved. He determined the amount of the curvature by letting down small glass tubes, which were partly filled with hydrofluoric acid, to different depths in the holes. At the end of about two hours the tubes were pulled up and the etching produced on them by the acid showed the direction which the holes took at the points where the tubes had rested.

The Silver Mines of Thunder Bay.

By Mr. Peter McKellar, F. G. S. A., Fort William, Ont.

A few years ago the Silver mines of Thunder Bay were in active operation and much mining development was in progress—now all are closed down. The depression in the value of silver—the advent of the new Mining Law—and about the same time, a number of the prominent mines had penetrated down into the silicious or poor bearing stratum of the Animikie rocks—these causes combined, resulted in the complete closing down of all the mines. Of course, in time, some of them will be re-opened, not all, as many mines were started without a showing to justify it, as is generally the case in all mining districts. Other new discoveries will undoubtedly be made here, as there are lots of unexplored areas under cover of drifts and alluvial deposits etc.

It was known to geologists and mining men for many years, that the veins were richer in silver within the argillaceous stratum than within the underlying silicious stratum; but few of the mining men had much knowledge of the thickness of either, and were often disappointed in their mining operations on this account. As this characteristic is becoming better understood, many of the misdirected efforts of the past may in future be avoided. At Thunder Bay the Animikie group of rocks covers an area of more than a thousand square miles. It consists principally of slaty beds, argillaceous and silicious, lying nearly horizontally upon the denuded upturned edges of the highly inclined Archean strata, which in this locality undoubtedly are largely Huronion schists. The thickness of the Animikie formation along the run of the western belt of silver mines, or from Silver Harbor to Gun Flint Lake, 80 to 90 miles, will probably average 600 to 1000 feet; but out towards the coast line it will be much thicker. The silicious or lower stratum, the lower silicious division of Mr. Ingall, is at the base of the Animikie rocks and is about 400 feet thick at the Duncan Mine, and nearly 700 at the Beaver Mine. It is not likely to exceed the latter thickness much anywhere along the northern silver belt. The carbonaceous clay slaty stratum that overlies the silicious stratum, shows a thickness of about 300 feet; but along the northern silver belt, it has been partly or wholly removed by erosion and denudation in places; and in others it is covered with a bed or sheet of trap which, again to the southward, is overlaid with slaty beds higher in the formation. In the mines along this belt, all the rich deposits of silver were found in the veins within this argillaceous stratum, which in the southward direction dips under higher beds of the formation. It remains to be proven whether or not the argillaceous beds of the higher horizons have the same favorable influence on the deposition of the silver within them, as the lower stratum has. From the past showing it would appear not, as in the great central belt, some ten miles or more in width, which lies immediately to the southward of the northern silver belt, no rich silver lodes have yet been found like the mines on the western silver belt. This apparent barreness of the central belt may be accounted for, 1st. That the lower argillaceous stratum is the real silver bearing startum of the formation, in which case the veins here would have to be mined down through the overlying beds to reach the silver bearing stratum; 2nd. The western silver belt seems to lie along a line of weakness, where there are many fissure veins, while along the central belt the veins are comparatively few and may not penetrate down to the metalliferous reservoir to which I will refer further on. I consider the search for the causes that produced these silver bearing veins a matter of much importance, that is, to try and find out if the silver ln the veins is due to lateral segregation, or if it ascended in the fissures from a deep source, to be deposited subject to the laws of attraction or to the influences of the adjacent rocks. If the infilling is by lateral segregation, it seems to me clear, that in the Animikie group the veins need only be worked down to the lower silicious division, for the underlying Archean strata are exposed in extensive areas, here and there, throughout the Algoma district. They show to be auriferous in many places; yet, they do not show to be argentiferous in this respect anywhere, I believe, excepting in the vicinity of the great Lake Superior trough, as at the Gopher and Star mines, Whitefish River, north of Whitefish Lake; the 3 A. mine north of Silver Harbor, Thunder Bay; Syrette location east of Nipigon Bay; the locations at the mouth of the Steel River; and the Little Pic silver mines, west of the Little Pic river. These are all in the Archean strata and carry silver ore similar to that of the Animikie veins, and in the case of the 3 A. and Gopher mines, rich ores. If the infilling is from below, we may look for these veins to prove valuable for mining to great depths, as the 3 A mine, and Gopher etc. prove that some of the Archean strata at least, have the influence to cause the precipitation of silver in fissures within them, when present in solution, as well as the argillaceous slates of the Animikie have. The gaeater showing of silver in the Animikie veins than in the Archean, may be on account of the Animikie area occupying the more favourable position in relation to the metalliferous reservoir below.

There is no doubt, the Thunder Bay silver veins are true fissures, as shown by the faulting of the walls. The Silver Mountain vein shows a fault of 60 to 70 feet; the Beaver vein, 15 feet; the Rabbit Mountain much greater; the Duncan mine vein 120 feet, etc.; so that the fissures must penetrate to a great depth. It seems certain that the copper and silver of the native copper mines of Lake Superior, were ejected from great depths with the fluid rocks of the Keweenawan group, and also that the fissures of the silver veins here, resulted from the subsidence in cooling of these great eruptions, and subsequent to the flow of the fluid rocks. The previous fissures formed were filled with fluid rock and show now as trap dykes in great numbers, especially along and near the coast. It is highly probable that those fissures cut down to the great reservoir from which the eruptive rocks of the Keweenawan were ejected, heated vapours, steam and aqueous solutions would ascend in the fissures, and carry metals and minerals along; and continue the ascension and precipitation of the solution subject to the influences of the adjacent rocks until the fissures were filled as we find them. In the event of the argillaceous beds having a greater influence in depositing the silver, than the interstratified silicious beds that the Animikie have, the veins within the former should show richer in silver than within the latter, as we find them. So also with the underlying Archean strata it is quite probable that the veins will be rich in silver within some of them and poor within others in a similar way.

The middle of the Lake Superior trough, the portion opposite Thunder Bay, appears to have been the most metalliferous part of the great reservoir for all the great copper mines are here on the one side and the silver mines on the other. Although the rock formations continue westward for 200 miles or more, the rich mines do not show excepting around the middle portion of the trough.

There are two series of fissure veins here; those of the one the most numerous vein nearly east and west, about parallel with the great trough; those of the other, cross and are prominently developed along the outer coast line, and rarely penetrate far inland. The position of the latter series near the middle of the trough, might be expected to prove richer than the other series of veins. The Silver Islet vein is one of them, and is certainly the richest one known thus far.

If it can be proven satisfactorily that these veins carry the silver in the underlying Archean strata, this locality is likely to prove a valuable deep mining district. I consider it quite probable that it will do so, in view of the natural conditions that bear on the matter, some of which I have in this paper endeavored to show.

In conclusion I may say in regard to the processes of lateral segregation and infilling of veins from below, that these are well known theories. The statement of mineral veins in the Encyclopedia Britannica remarks, "But that this mineral matter came chiefly from below appears almost certain."

Gold in Ontario and its Associated Rocks and Minerals.

By Dr. A. P. Coleman, Toronto.

Since the discovery of the Richardson mine in the township of Madoc, in 1866, gold has been found at hundreds of points in Ontario, from the Madoc region in the east to the Lake of the Woods in the extreme west. In this distance of 900 miles there is nowhere a gap of more than about 100 miles between known gold deposits, except in the little explored region north east of Lake Superior, where gold has not been discovered for a stretch of 175 miles It will be convenient to speak of three gold regions in the province, a south-eastern one in Hastings county, a central one reaching from Wahnapitae to the Sault, and a western one extending from Lake Shebandowan to the Lake of the Woods. A few isolated discoveries lie outside these areas, and it may be that future finds will connect the three gold regions into a single one including the whole Archaean portion of Ontario.

Unlike most gold regions, Ontario has no placer deposits, a consequence of intense glacial action which has swept away all gold bearing sands and gravels and so mixed them with barren materials in the immense beds of drift found in the southern portions of the region as to make placer mining hopeless. It is said that colors of gold may be washed from the sands of Toronto Island, and probably traces of placer gold could be obtained at many other points by perseverance in panning, but nowhere in paying quantities. In this respect Ontario resembles Nova Scotia and differs from Quebec with its Chaudiere placers, and still more from British Columbia.

Another important result of ice action has been the more or less complete removal of weathered products from the surface of veins, so that the sulphides which regularly accompany gold bearing quartz in all parts of the world below water level are here found as a rule only a short distance beneath the surface; implying that no large amount of thoroughly free milling oxidized ore can be obtained from our mines, and that the more refractory sulphide ores must be treated from the very first. The points just mentioned account largely for the slow advance of gold mining in the province.

The gold from our mines is unusually pure, resembling in this respect the gold o Nova Scotia rather than that of British Columbia. Assayers notice that Ontario gold ores, when free from galena or copper pyrites, yield buttons with little more silver than is accounted for as coming from the litharge or test lead employed in the assay. Probably the proportion of silver is generally less than five per cent., though exceptions occur to this rule. Dr. Lawson states that in some gold ores from the Lake of the Woods "silver occurs in the auriferous quartz veins, generally as an accessory mineral, in small quantities, but sometimes, as the assays of the Pine Portage mine show, in greater proportion by weight than the gold."*

Our gold appears in the usual forms as nuggets, scales, etc., and never, so far as I have observed, in crystals, though crystals of gold have been reported from the interesting new region of Wahnapitae. Specimens from that lake in the museum of the School of Practical Science, Toronto, show smooth planes, but apparently only an impress from adjoining quartz crystals.

* Geol. Sur. Canada, 1885, p. 142, C. C.

Of the minerals associated with gold quartz is by far the most constant, so that miners and explorers are apt to call every gold ore, no matter what its composition, quartz; if, indeed, they do not refer to it as a "quart," with the idea that a single specimen should be spoken of in the singular, not in the plural. The gangue quartz of Ontario gold ores varies greatly in character. Often as found at the surface it is rusty and porus, "good looking rock," while a short distance below it contains sulphides and is quite different in appearance. The quartz may take on crystal form and be more or less clear and transparent, as in some specimens from Wahnapitae, or it may be massive or bluish-gray, as in the ore from the Ophir mine in Galbraith township, or the Sultana mine near Rat Portage. Some of the latter quartz, which is distinctly schistose and has a crypto-crystalline appearance with thin bands of chlorite or hornblende running through it here and there, might properly be described as quartzite. In other regions the quartz is apt to be fine grained and milky or dull white, as at the Partridge mine near the Atikokan, or the Ledyard mine in Belmont. From the latter locality come some beautiful specimens of white cellular quartz with specks of gold disseminated over the walls of the cells. In the same quartz Mr. McAree has observed small red jaspery concretions.* Sometimes the quartz is stained to a pale red with films of hematite, as at the Ray-Wiegand mine on the Seine river, or green with malachite, as in the McGowan mine near Parry Sound.

In texture, then, the quartz may form crystals or coarse or fine grained crystalline masses, or it may be cryptocrystalline and compact. Its color may vary from pure white to greenish black, or it may be stained red or brown or green with iron or copper compounds. It may be almost transparent, or only translucent or quite opaque. It may be true vein quartz or a schistose quartzite. A few other oxides occur in our gold ores, especially the brown hydrous and the red anhydrous oxides of iron in weathered surface ore. Vennor states that gold has been found embedded in the third oxide of iron, magnetite, in the Madoc and Marmora district, and that Prof. Bell of Albert College, Belleville, found oxide of tin in a specimen of ore from the same district.† A similar association has been observed at the Vermillon mine in the Sudbury region, where small amounts of cassilerite occur.

Sulphides of one kind or another are almost universal accompaniments of ores of gold that have not been subjected to weathering, the most prominent, of course, being iron pyrites, whose brassy gleam may be seen in most of our gold ores. It displays the usual crystal forms, cubes with striated planes or pentagonal dodecahedra. Crystals almost an inch in diameter are sometimes found in the Belmont ores. The common occurrence of pyrite with gold is no doubt accounted for by the mode of transport and deposit of the metal, sulphate of iron having the power to dissolve small quantities of the metal. Any reducing agent, such as organic matter, destroys the solvent by forming sulphide of iron, the gold being deposited at the same time This theory satisfactorily accounts for the particles of gold o ten found embedded in the pyrite. If the particles are above a certain size they are more or less completely liberated by crushing and may be saved by amalgamation. Such sulphide ores are partially or wholly free milling. If the particles are very minute many of them will not be set free by simple crushing, and the ore is refractory. It is worthy of note that some of our ores which have been looked on as highly refractory, so that thousands of dollars have been spent on chlorination or other plants with which to treat them, have turned out to be almost completely free milling. An excellent example of this is to be found in the Sultana mine, from whose sulphide ores 92½ per cent. of the gold is extracted in the stamp mill, and the small quantity of concentrates obtained hardly pays for treatment.

In the Sultana ore one frequently sees specks of gold embedded in the quartz entirely apart from the iron pyrites. It is clear that this gold cannot have been deposited in the way suggested above. Perhaps this and the nuggets sometimes found in pure white quartz at the neighboring Ophir mine have been carried in the form of a gold silicate, as suggested by Bischoff and other writers.

The cellular white quartz from Belmont doubtless once had its cavities filled with pyrite crystals like those now found below the level of weathering. The sulphide has been oxidized into sulphate and leached out, one stage of the process being perhaps the formation of hydrous sesquioxide of iron and of siderite.

I am not aware that the marcesite variety of iron pyrites has been found in our gold ores, but pyrrhotite, the lower sulphite, is not infrequent in the Lake of the Woods region.

Small amounts of copper pyrites are often found accompanying the iron pyrites in our gold quartz, sometimes largely replacing it, as at Oliver Daunais' Wabigoon mine. The other copper sulphides, bornite or peacock ore, and chalcocite or copper glance, are much less common. In one very interesting deposit found last spring near Parry Sound these two minerals occur in large quantities in the quartz, far outweighing all the other sulphides, and small nuggets of gold may be enclosed in them or lie between the copper ore and the quartz. An assay of some of this bornite free from visible gold gave ½ ounce per ton, with a very small per centage of silver.

Mr. Coste in his report on the Lake of the Woods region mentions the somewhat rare sulphide of copper, covellite, as occurring with iron and copper pyrites, bornite and other sulphides in the gold ores from that part of Ontario.‡

The only other sulphides which I have observed or seen mentioned in connection with our gold ores are galena and zincblende. The former is often found at the Lake of the Woods and Rainy Lake and is there considered a favorable sign, since it is generally associated with free gold. The cause of this relationship is not easy to understand, for the galena itself does not usually carry any important amount of gold. Zinc blende is found in small quantities in mines near Port Arthur and Marmora, but seems to have little influence on the gold contents of the ore. The sulphides of iron and copper seem much more efficient as gold bearers than those of the other metals.

The only compounds of arsenic or antimony found in our gold veins are mispickel and tetrahedrite. The latter mineral has been reported from only one locality, so far as I am aware, the Empire mine in Madoc, where Vennor found it forming small gold-bearing veins with calcite, magnesite and quartz in dolomite.§ Mispickel, on the other hand, is rather widely spread in the gold deposits of the Province, being found in small quantities in ores from the Lake of the Woods, and in immense amounts at the Gatling and other mines near Delora in Marmora. The mispickel of Delora occurs sometimes as very pretty roseate-like twinned forms or as crystals of prismatic habit, but more commonly in fine or coarse-grained masses. According to Prof. Chapman,‖ it averages from one or two to seven or eight ounces per ton of gold, and the value of the ore is considerably increased by the large amount of arsenic it contains; but the ore proved so refractory that the expenditure of hundreds of thousands of dollars in elaborate reduction works resulted only in failure.

A quite similar ore was worked, apparently at a profit, many years ago at Goldberg in Silesia, where the arsenic was made a valuable part of the output. It is prob-

*Papers of Engineering Society, S. P. S., p. 26, etc.
†Geol. Sur., Can , 1871-2, p. 131.
‡Geol. Sur. Can., 1866-69.
§Geol. Sur., Can., 1866-69.
‖Minerals and Geology of Central Canada, p. 307.

able that improvements in method may yet cause these mines to be valuable. In considering the province as a whole one should remember that arsenic in amounts sufficient to make the ore very refractory is confined to this narrow belt of territory. The Belmont mines, a few miles away, show no trace of mispickel.

Tellurium occurs apparently in only one locality in the province, in the sylvanite of the once famous Huronian mine west of Port Arthur.

The other minerals associated with gold in the province are not specially important. Free gold may sometimes be found in the silicates forming the wall of veins. A pretty specimen from Wahnapitae, now in the museum of the School of Practical Science, Toronto, contains several small nuggets completely enclosed in green chlorite. Vennor refers to occurence of gold in dolomite and calc-spar;* and describes the wonderfully rich cavity of the Richardson mine in Madoc, where the first gold was discovered in Ontario. The gold was here found in a "reddish brown ferruginous earth in which were scattered fragments of a black carbonaceous matter, the latter showing when broken, small flakes and scales of the metal."† Specimens of free gold from Marmora, in the School of Science collection, are associated with a somewhat weathered siderite. Probably some of the rusty quartz with free gold from this and other parts of the province, results from the decay of siderite or other carbonates rich in iron rather than from the weathering of sulphides.

Turning now to the rocks in which the gold deposits of the province occur we find that they are all very ancient, most of them Archaean. The south-eastern region, that of Marmora, Madoc, Belmont and other townships, is probably the most ancient, belonging to what Vennor calls the Hastings series, believed by him to be the equivalent of the lower Grenville series of Logan, *i.e.*, to the lower portion of the upper division of the Laurentian. It is possible, however, that these rocks are really a small area of greatly modified Huronian. The remarkable gold bearing deposit of Parry Sound is probably of the same age. All the other important gold districts are Huronian, if we assume that Lawson's Keewatin is in reality of that age.

Dr Chapman, however, has obtained gold from a vein in Keweenian rocks at the Enterprise mine on Black Bay, Lake Superior; and gold has been found in the Animikie, north and east of Port Arthur,‡ showing that the precious metal does occur in rocks younger than Huronian, probably lower Cambrian.

Lithologically, the rocks in which gold has been found in Ontario, vary greatly. Vennor describes the famous Richardson mine as occurring at the contact of a "chloritic and epidotic gneiss with a silicious ferruginous dolomite." It was in a cavity at this contact that the thousands of dollars worth of rusty earth thickly spangled with flakes of gold were found, which roused a gold fever the like of which has never been experienced since in the staid province of Ontario. In several other parts of the Hastings series Vennor finds gold in veins running through dolomite, in silicious dolomite or at the contact of mica slate and dolomite. With the dolomites are mentioned various schistose rocks, talcose, micaceous, chloritic and hornblendic. So far as mining experience goes in Hastings, the deposits in connection with dolomites are merely pockets, sometimes rich, but quickly exhausted. Vennor believed that the gold of the region is in close association with the summit of an iron bearing band.

The only specimens of country rock from the region which I have examined, are from the Belmont mine. The specimens, which are greatly weathered, consist of diorite, perhaps originally diabase, and chloritic schist. The latter contains a large amount, almost 50 per cent., of a carbonate, calcite or dolomite. Mr. McAree, who examined the country rock of the Crawford mine in the laboratory of the School of Science, found it to be weathered diorite, with chloritic schist in the walls.§

The gold of the McGowan mine, Parry Sound, is found in a bedded vein resting on a dark diorite-schist and covered with a mica-diorite schist. A few feet above this a bed of dark grey rock turns out to be a gabbro. Mingled with the quartz is a rock consisting of quartz, muscovite, garnet and a little augite, a combination hard to name. Not far off one finds dykes of very coarse grained pegmatite and a large extent of gneiss, while a bed of impure crystalline limestone occurs a mile to the west. It is somewhat doubtful if this association of rocks should be placed with Vennor's Hastings series, but it differs decidedly from the typical Huronian and from Lawson's Keewatin. As this is a new locality the rocks have been mentioned in some detail.

Passing to the central gold region, the rocks containing the gold deposits about Lake Wahnapitae have, so far as I am aware, never been carefully examined, though Bell maps them as Huronian with eruptive masses of diabase and diorite, the Huronian being defined as consisting of a variety of crystalline schists and stratified clastics, such as greywacke.

The country rock of the Vermilion mine is Huronian, but of just what character I am not aware.

A specimen of the country rock of the Ophir mine in Galbraith Township, submitted to me by Mr. Blue, Director of the Bureau of Mines, though greatly weathered, is pretty certainly a diorite.

Going still farther west we find some gold-bearing veins in the dark Animikie slates, north and west of Port Arthur. No doubt the eruptions of fine grained diabase which traversed these rocks and covered them with widespread beds of lava have had a great influence on the formation and filling of the gold veins, as well as those of silver, in the region.

The Huronian mine, unique in Ontario as containing the rare mineral sylvanite, doubtless occurs, as its name suggests, in the Huronian, but I have not seen any detailed description of the enclosing rocks.

We now come to one of the most recent gold regions of Ontario, that of the Seine River and Rainy Lake, where fortunately the geology has been, in many parts, quite carefully worked out by Lawson and his assistants and successors. Lawson's excellent map shows rounded areas of Laurentian gneiss, granite or syenite enclosed in wide meshes of Conchiching gneiss or mica schist, underlying the Keewatin schists, probably of Huronian age. Up to the present gold has never been found, so far as I am aware, except in or near the latter group, which consists of a complicated series of schistose, massive and fragmental rocks. The schists are either basic in character and of some green shade of color, or acid and yellowish or brown. The green schists are probably of volcanic origin and are mixed up with massive fine grained diabase, the latter being probably solidified lavas, while the schists represent ash beds. The green schists are sometimes soft and chloritic, at other times hard and hornblendic. The acid series of rocks represents, according to Lawson, a later series of volcanic products resembling quartz, porphyry and related rocks originally, but now turned by metamorphic action into schistose, felsites, etc. Besides the rocks mentioned, distinctly fragmental rocks, such as graywackes and even schist conglomerates occur in large amounts. Of these rocks the softer green schists naturally appear the most promising, and many gold bearing veins have been located in them, almost always of the bedded variety. Examples of this are found in the well known Little American mine, where a series of lens shaped quartz veins dip steeply (82°-85°) to the south, between layers of chloritic and hornblendic schist. Free gold has however been found also in bedded veins in schist apparently of the felsitic or acid type, as in the series of locations north of Wild Potato Lake, an expansion of the River Seine. The most talked of claims of all in this region, the Ray-Wiegand property and adjoining ones, which are now being developed, show free gold at many points and assay well, but are of a totally different character. They are distinctly fissure veins, with sharply defined walls, crossing the general trend of the schists of the region. These veins are not in the schists, but in a peculiar quartzose granite, not very far from the contact with the Keewatin schists. Some other bosses of granite, and also of a very coarse grained gabbro, or perhaps anorthosite, since the white felspar greatly predominates, lie just to the west on Bad Vermillion Lake.

The rocks of the Manitou region to the north are of the same general character, but have not yet been mapped.

On a claim owned by LaCourse, a pockety vein which has provided a great number of handsome specimens, lies in a gneissoid rock that looks very different from the ordinary Keewatin, and may be Conchiching, but I wish to examine thin sections of the specimens taken before speaking positively. Another claim which is now being developed at the north end of the lake, shows bedded veins of quartz with visible gold in Keewatin graywacke.

The massive diabases of the Rainy Lake and Manitou contain few quartz veins, and these are apparently not auriferous.

The most westerly gold field of Ontario, that of the Lake of the Woods, has been before the public for a number of years and is fairly well known as compared with the territory just to the east.

The Sultana mine, which produces its brick of gold with great regularity, works a bedded vein in green and gray chloritic and hornblendic schist. On the same island or point we find a vein striking in a quite different direction and enclosed in a somewhat coarse syenitic gneiss. This is the Ophir mine, which has produced such wonderfully rich specimens of free gold.

The Bad mine, near Rossland, which also provides specimens rich in free gold, is on a quartz vein lying upon gray syenitic gneiss and having a few feet of fine grained flesh-colored gneiss or granite just above, followed by the syenitic gneiss again.

Other mines in the same vicinity have been sunk upon bedded veins in green schists of the usual Keewatin type, but nowhere far away from the syenitic gneiss.

In summing up the results of this very brief survey of a very wide field, one may say that the gold of Ontario is generally alloyed with only a small percentage of silver, and is usually found, as in most other regions, in quartz containing iron pyrites or other sulphides, or the oxides resulting from their decomposition. Much of it is free milling, and very refractory ores, such as tellurides or arsenic compounds, occur in only two localities. In the western part of the province the presence of galena or copper pyrites is believed to indicate rich ore.

In the majority of cases the gold-bearing veins are of a bedded character, especially those in highly schistose rock. In the eastern part of the province the enclosing rocks are rarely more or less pure dolomites, but are often diorites, diabases or gabbros, or schistose modifications of these rocks, and belong probably to the upper Laurentian. In the western region the chief country rock is the green Keewatin schist of the Huronian, rarely the brownish felsitic variety, and in these rocks the veins are bedded. Gold-bearing veins in this region occur chiefly near the contact of the schists with granite or syenitic gneiss. At a few points true fissure veins with much free gold occur in the granite or syenitic gneiss, but, so far as known, close to the contact with the green schists.

*Geol. Sur., Can., 1866-69, p. 167.
†Ibid, p. 165.
‡Min. and Geol. Central Canada, p. 301, etc.
§Papers of Eng. Soc., S.P.S., p. 26, etc.

Diabase Dykes in the Sudbury Mining Region.

MR. T. L. WALKER, M.A.‖

(Continued from Page 25.)

	I.	II.	III.
	Per Cent.	Per Cent.	Per Cent.
$S_1 O_2$	47·22	49·88	51·22
Al_2O_3	16·52	18·55	14·06
$Fe_2 O_3$	3·32	2·06	4·32
Fe O	12·40	8·37	8·73
Mn O	·04	·09	·16
Ca O	9·61	9·70	8·33
Mg O	3·33	5·77	4·42
K_2 O	·67	·68	1·25
Na_2 O	3·40	2·59	2·55
H_2 O	·30	1·04	1·28
C O_2	....	....	·19
Ti O_2	3·62	1·19	2·42
$P_2 O_5$	·33	·16	·25
Fe S_2	....	....	·49
Ba O	·01	·02	....
N_1 O	·0275	....	....
Co O	·0055	....	....
Cu O	Trace	....	....
Total	100·803	100·10	99·67
Spec. Grav.	3·01	2.97	2·98

The proportion of ferrous oxide is much higher than usual, as is also the titani acid. This latter doubtless occurs partly in the ilmenite and magnetite, and partly in the augite, giving it its characteristic violet color. The small amount of oxide of barium was found by working with a large quantity. Mr. Hildebrande (6) has recently shewn that the occurrence of this element in rocks is much commoner than formerly supposed. About eighty grams of the rock powder was fused with an arsenical flux and the resulting arsenide buttons were treated for copper, nickel, and cobalt. In this way the quantities of cobalt and nickel could be easily separated and weighed. It has long been known that nickel is a frequent constituent of the heavy ferro-magnesian minerals, especially of pyroxene and olivine, and it is quite probable that in this case the nickel, cobalt and copper occur in these minerals. Whether these metals were primary constituents of the magma or not, it would be difficult to say. They may be derived from the nickel-bearing greenstones, as the diabase dykes cut through them and possibly through some of the nickel deposits associated with the greenstones. It is easier to regard the original diabase magma as containing the heavy metals. No nickel deposits have been found associated with the dykes.

The quantity of nickel contained in this rock may seem to be only trifling, but there is more nickel in one of these dykes than in the best nickel mine in the Sudbury region. Take the dyke which crosses the railway between Sudbury and Murray mines. This dyke has been traced for three miles, though it is probably much longer, and is at places 150 feet wide. It contains enough nickel to form a band of 2 per cent. nickel ore over two feet wide and as long as the dyke. If it were all concentrated in one mass, the deposit of 2 per cent. ore would be forty-eight feet wide and one-eighth of a mile long. The deposit would have the same depth as the dyke. This would yield 10,560 tons of 2 per cent. ore for every foot in depth, or 1,056,000 tons for the first hundred feet in depth. This would represent 21,120 tons of metallic nickel, or enough to supply the market for ten years. This is for only one dyke, counting only three miles as its length. But this low percentage of nickel is of no value whatever. Nature has not concentrated the nickel here as she did in the greenstone areas. Had the diabase cooled more slowly and contained a considerable quantity of sulphur, then the nickel contents of this rock would doubtless have concentrated in lenticular masses along the wall, so as to be available for mining purposes. These conditions were present, however, in the case of the nickel-bearing greenstones, and consequently we have large masses of nickel ore.

A Few Notes on Merchantable Mica in the Laurentian.

By Wm. Hamilton Merritt, F. G. S., Assoc. R. S. M. S., &c.

Mica mining may properly be said to be in its infancy, and until quite recently had nowhere arrived at the dignity of mining, the operation consisting for the most part in making irregular surface pits where mica crystals were discovered at the surface.

This condition was chiefly due to the fact that the consumption of the mineral was very small. Electricity has, however, brought about a much larger demand for mica, and it is expected that mica-mining will assume considerable importance in the near future.

Last year, up to Dec. 1st, $26,257 is given by the Customs Department as the value of shipments to the United States and Europe—chiefly the former.

During the past summer I had occasion to visit some of the mica deposits in the Kingston district in Ontario, and near Ottawa and in the Saguenay district in the Province of Quebec.

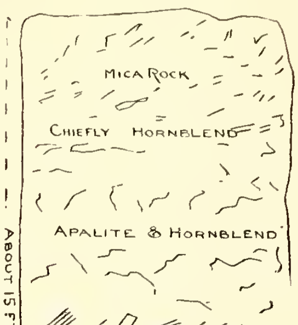


Fig. I.—Section of Smith and Lacey Mine, Sydenham, Ont.

It has occurred to me that it might possibly prove of interest to record a few notes on the occurrence of some of the deposits, for I think it is a subject well worthy of investigation, and all the information relating to it should be collected by our Institute. In fact I do not know of any economic mineral substance in which there is a larger field for investigation than that of mica deposits.

Dr. R. W. Ells has given a very interesting and valuable communication on "Mica Deposits in the Laurentian of the Ottawa District" to the Geological Society of America. He gives six principal modes of occurrence for mica in that district.

It may be open to question whether a specific number of conditions can properly be laid down at present. Without doubt the deposits examined by Dr. Ells occurred as he described, but it may be possible that he would have expanded the number of conditions if more deposits had come under his attention. With reference to my own general observations, I may say that, as you probably all know, and as explained by the title of my paper, the mica bearing formations of eastern Canada occur in the Laurentian.

Nearly all of these old crystalline rocks carry more or less mica, but only in certain belts, and in limited areas in these belts is mica found in large enough crystals to be of commercial value.

The mica occurrs in two classes of rocks:

1. In granite—the mica being associated with quartz and felspar, and generally present as muscovite, or white mica. Other minerals, such as tourmaline, garnet, phosphate and common emerald, are very often found in a crystalline form associated with this class of deposit.

It is evidently where the crystallization of the rocks has been slowest that we find the merchantable mica, for the other components of the rock accompanying it are also more or less equally well developed, and we not only find larger crystals of mica, but the crystals of the other minerals composing the rock are of a correspondingly increased size. It is therefore advisable to note the general crystalline character of the rock masses where mica crystals appear at the surface and mining operations are contemplated.

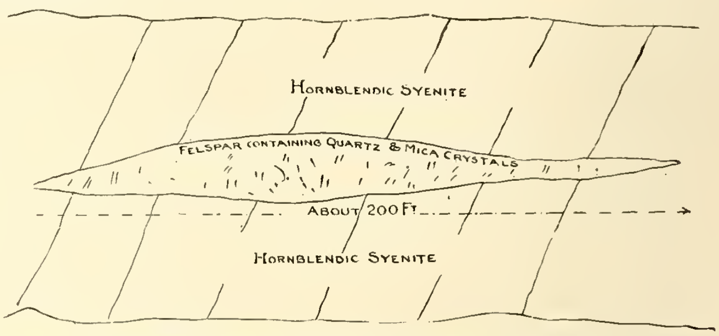


Fig. II.—Lenticular Mass or Vein of Feldspar with Mica Crystals, Murray Bay Mine, Que.

2. Associated with hornblendic or pyroxenic rocks—chiefly hornblendic syenite, often gneissic, but in cases graduating from a pyroxenic syenite to a diorite or gabbro. In this latter class of deposit the mica is either found associated with hornblende or pyroxene and apatite, or in veins or irregular masses of calc-spar or felspar (with more or less quartz) cutting hornblendic or pyroxenic syenite. The mica is chiefly phlogopite or amber mica, and sometimes biolite or black mica is found.

It is remarked that where the hornblende contains a larger quantity of iron (typical black hornlende) the mica is darker, and when the mica is associated with the lighter colored actinolite it is found to be amber colored or almost white.

Working of Mica—Before proceeding to illustrate the above mentioned general classification of deposits by a few examples, I shall give a note or two about the working of mica.

It may correctly be inferred from the above remarks that the occurrence of the larger (or merchantable) crystals, is somewhat irregular and precarious, and such is found to be the case. Indeed, in most formations the crystals are much twisted, broken by joints, with embedded crystals of quartz or calcspar in them, and sometimes spotted with iron or manganese stain, or minute crystals of tourmaline or magnetite.

It is perhaps more difficult to put a price upon the cost of mining mica than upon any other mineral, though it be conceded that all mineral occurrences vary greatly in the cost of their yield.

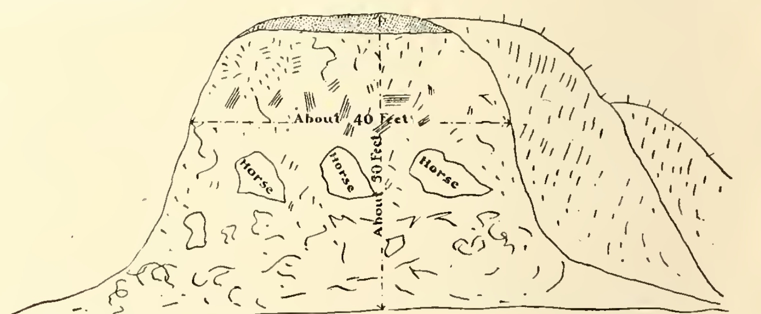


Fig. III.—Face of Cliff—Mica bearing Ridge—Hall Mine, Saguenay District, Que.

Mica mining being quite in its infancy, the most economical manner of attacking and mining the mica remains yet to be determined. It will, however, probably be in the direction of cheapening the excavation of the rock containing it, by operating on a large scale where the formation warrants it. Most of the mining has been done up to the present in Canada by merely making pits where crystals were formed of any size.

When the mica is associated with apatite, as is very often the case, that mineral yields a good price, and the felspar, which is in other cases largely developed in association with the mica, has been exported, but the extensive use of this mineral at remunerative prices to the producer, remains for further developments.

From instances observed, it may be said that in exceptionally favourable cases 20 tons of rock may yield a ton of merchantable uncut mica, and it in turn gives a very good result if from 4 to 10 tons yield one ton of cut mica. In one case in a yield of 23 per cent. of cut mica, 7 per cent. was No. 1, and 16 per cent. was No. 2. Sizes running from 6in. x 7in. down to 1½in. x 2½in., the smaller sizes being much the most numerous.

It is a somewhat strange coincidence that 23 per cent. is the exact yield of a well known Indian mine, as given in a very interesting article on Indian mica in The Canadian Mining Review.

(6) Journal Am. Chem. Soc., Feb. 1894.

One deposit yielded from 1½ to 7 tons a week of uncut mica, for six men employed.

The cost of getting the rock carrying the mica may vary from 50 cents to $2 per ton, and almost any shot in most mica deposits may bring an altered condition for the time being.

The cutting of the mica may be said to cost from $50 to $100 per ton of cut mica produced, depending upon the size and quality of the mica crystals.

The resulting cut mica furnishing a varying quantity of first or second class mica, and the price obtained for the product increases immensely in proportion to the sizes of the sheets, and whether the mica is pure white or dark amber color.

There are a variety of uses for the waste mica produced in the cutting, and the emand for this is constantly increasing, but the enormous quantity of defective ystals produced in mining may be said to be of no value.

The following are examples of the occurrence of mica:—

1. In Bedford Tp. Frontenac Co., Ontario—Mica crystals are associated with apatite in a hornblendic belt, occurring in a syenitic gneiss. Mica dark amber-colored phlogopite.

2. In same locality as No. 1—(*a*) Mica is largely developed in a light colored gneissic syenite band, varying from compact to highly crystalline, and where the large crystals are developed it has been mined in connection with phosphate, which occurs with it.

(*b*) At one place the formation is cut with a distinct calc-spar vein, 5 to 8 ft. wide, and large mica crystals occur in this with light colored hornblend masses. The mica is light amber-colored phlogopite.

3. In Loughborough Tp. Frontenac County, Ont.—A strong belt of a quartz syenite carries mica crystals. Largely crystalline quartz and felspar, with patches of light colored hornblend, contains mica crystals chiefly associated with the latter mineral. The mica is light amber-colored phlogopite.

4. In same Tp. and County as last—A belt of quartz syenite in large crystals carries mica. The quartz, felspar and light actinolite crystals are largely developed. The mica is light amber-colored phlogopite.

5. In Portland Tp., Frontenac Co., Ont. — Crystalline syenite, with light colored, almost white, amber mica.

6. Hichinbrooke Tp., Frontenac Co., Ont.—A diorite (spotted), quartzose in places, and varying in colour from grey to blackish colored with dark hornblend, contains mica with phosphate and magnetic iron. Mica is black biotite.

7. Loughborough Tp., Frontenac Co., Ont.—A belt of hornblendic rock contains a zone of large hornblend and mica crystals occurring with apatite. Mica is dark amber colored and has been found in crystals seven feet square.

8. North Burgess Township, Ont.—A hornblendic rock which has decomposed to a green steatitic rock, about 50 yards wide, occurs between a quartzose gneiss and a felsitic gneiss and is mica bearing. The mica is light coloured amber phlogopite.

9. Hungerford Township, Hastings County, Ont.—A granitic gneiss contains mica and tourmaline crystals. Mica is white muscovite but at times spotted with minute tourmaline crystals.

QUEBEC.

10. Hull Township, Ottawa County, P.O.—A dark coloured augite (diallage) syenite is cut with strong veins of calc-spar up to 15 feet wide. The veins carry mica crystals. Mica is dark amber coloured and somewhat spotted.

11. Murray Bay District, North Shore River St. Lawrence, P.Q.—A lenticular mass, or possibly a vein, of felspar with quartz horizontally cuts a dark hornblendic gneissic syenite which dips almost vertically.

The felspar mass has been opened for nearly 200 feet and shows a thickness of from 15 to 20 feet at the widest place running down to a few feet. The mica is scattered in bunches of crystals. The felspar and quartz assume the character of graphite granite occasionally and more commonly that of pegmatite. Large quantities of pure felspar are obtained. The mica is found both as white muscovite of excellent quality and also as phlogopite of an amber shade, a peculiar transition occuring very abruptly.

12. Saguenay County, Que.—A granite ridge has the quartz, felspar and mica largely developed in crystalline form. The general character of the ridge is in the main quartzose with development of felspar and mica crystals, and more rarely crystals of tourmaline, garnet and phosphate. The ridge appears to have a stratification which is nearly vertical. On the flanks of the ridge a gneissic form appears with hornblend and some calc-spar, but the main body of the ridge consists of quartz, felspar and mica, the former largely predominating, some in the form of "rose-quartz." The crystallization is large in certain irregular zones where mica is mined. Large-horse like masses of greyish fine grained rock come in here and there, with the larger crystallized rock occuring between them. The whole body of the ridge carries small mica crystals. The mica is muscovite, white and strong. The mica crystals are often impaired with quartz crystals lying embedded in them, sometimes partly cutting through the mica crystal or entirely piercing it.

Description of Webber's New Miner's Dial.

By Mr. Hort. Huxham, M. Inst. C. E.

(South Wales Institute of Engineers.)

The chief objects aimed at in the construction of this improved dial, or circumferentor, are greater facility for reading, increased accuracy of work, portability and reduced cost.

The instrument (see plate) consists of an ordinary tripod stand, of any convenient height according to the nature of the work, and provided with parallel plates for adjustment of level. In lieu of the parallel plates, however, may be substituted either an improved Hoffman's or Pastorelli's ball and socket joint if thought preferable for some class of work

The upper parallel plate is provided with a male axis, which fits into the socket forming the bottom of the body piece of the instrument. This axis is grooved in the usual way to receive the end of a milled-headed clamping screw passing through the socket, so that the head of the instrument may be set horizontally in any direction on loosening the clamping screw.

The hook for attaching the plummet to is carried through a central opening left in the tripod head, and is attached to the ball pin of the parallel plates, so that whatever may be the amount of displacement of the parallel plates in levelling up, the hook will always be in the vertical axis of the instrument.

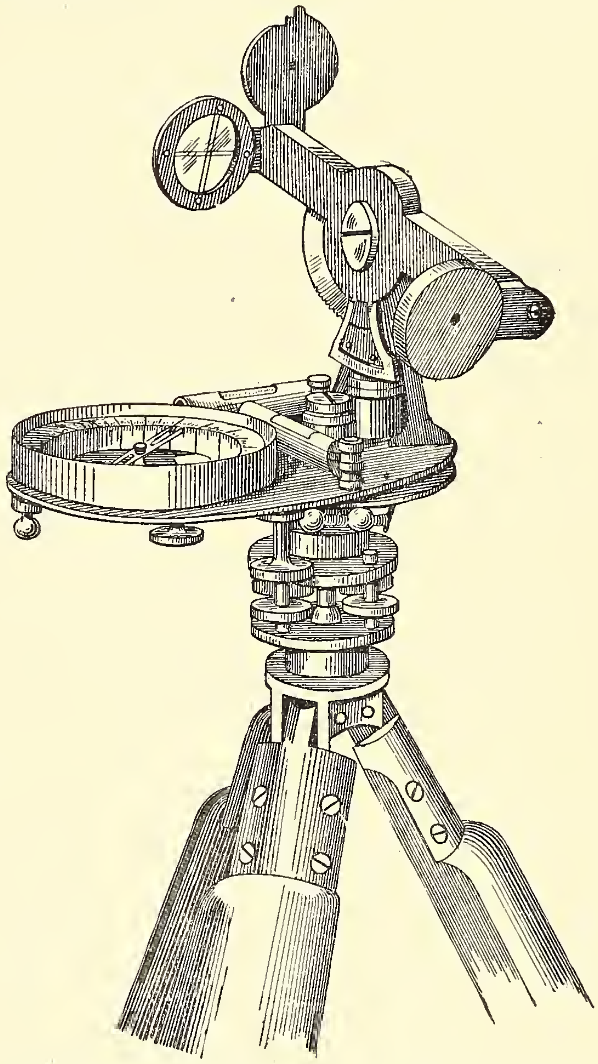
The lower plate, or limb, attached to the body piece is 3⅞ inches in diameter, and is fitted on its outer circumference with a rack, and on its upper surface with a horizontal circle divided from zero to 360 degrees.

The central vertical axis of the body piece is slightly prolonged above the lower horizontal plate to carry the upper horizontal or Vernier plate, which is of an oblong form, 7 inches by 4⅛ inches, the centres of each end of which are 3 inches apart. One end of the upper plate is centered on the vertical axis of the instrument, and has a flange cast on its under side, which completely encircles and protects the lower plate; to the under side of this flange is attached an annular shield plate, thus completely boxing in the lower plate.

The other end of the upper plate projects 3⅛ inches over the lower plate and forms the base of the compass box, which is 3¾ inches in diameter, and is thus placed three inches out of centre, or eccentric to the central axis of the instrument. This affords a clear and unobstructed view of the compass, and gives greater facility for accurate reading.

The bottom plate of the compass is divided from zero to 90 degrees from north and south towards east and west, whilst the step is divided from zero to 360 degrees.

The compass is fitted with a pair of edge bar needles with sliding riders, and reading points placed between the needles. It is also furnished with the usual lift to raise the needles off the central pivot. The compass box has a plate glass cover, and also the usual metal lid.



The Vernier is placed in an aperture in the bottom of the compass box, through which the readings of the lower limb are taken. This arrangement admits of the Vernier and the limb being placed on the same horizontal plane, and thus tends to greater facility and accuracy of reading. The Vernier and limb are entirely enclosed and protected from dust or injury, the only portions visible being those seen through the reading aperture in the compass box.

The Vernier plate and compass box is furnished with a rack and pinion motion, and provided with a clamp and tangent screw. On the upper side of the plate are affixed two cross levels for levelling the instrument.

The sights and vertical arc are carried by a swivelling axis mounted on a pillar, securely attached to the upper or Vernier plate by a strong milled-headed screw and set studs. This makes the arrangement very portable, as the pillar is readily detached for packing in the case.

The rocking motion of the sight-piece allows of angles up to 45 degrees being read on the vertical arc.

The sights are formed of two windows, or circles of metal, placed opposite each other at a distance of 7 inches apart. Each window has two pairs of parallel hairs stretched across it at right angles to each other, thus forming a small square in the centre. In lieu of the hairs, the windows may be filled in with parallel glasses having the sight-lines etched on them.

The windows at either end are covered by revolving metal shutters, each having a small eye-hole in the centre corresponding with the central axis of the windows; each shutter or eye-piece can be brought down to cover the window or turned away from it, according to whether a forward or a back sight is being taken, without in any way altering the set of the instrument.

This arrangement enables the instrument to be clamped at one station and carried forward to the next, and sighted back to the station just left without any reversal of the sights.

The line of sight cuts both the vertical and horizontal axis of the instrument, so that there is no correction needed for parallax, and the readings can be plotted as taken.

The vertical arc, fixed to the sight-piece, is read by a Vernier, and is fitted with a rack and pinion motion and clamp and zero stop; it is also provided with a scale of differences of hypothenuse and base.

The instrument is 7½ inches in height above the tripod head, and packs away in a case 8¾ inches by 5½ inches by 5½ inches, outside measurement.

CORRESPONDENCE.

Minerals in the Parry Sound District.

To the Editor:—

Some time ago when looking for land I came across some promising outcrops of minerals, notably copper and I believe gold, but having no means either to prospect myself or take up the land, perhaps you might find space for this in the hope that some mining man or company might acquire or work the lots. I can give the numbers of the lots, concession line and township; but in the event of any mineral deposit being opened would like to get a fair share of the value.

THOMAS NIXON.

92 Clinton St., Toronto,
11th Feb., 1895.

Mica in British Columbia.

To the Editor:—

Through the kindness of the editor of the *Inland Sentinel*, Kamloops, B.C., I have been favored with your issue of December, 1894, in which, among other very valuable information regarding mining data throughout the Dominion, considerable space was given to the product and use of mica in the commerce of the world. Having, for some time past, devoted my attention to the determining of the mineral resources of a certain section known as the North Thompson in this province, induced me recently to interest myself in and determine the extent of the mica deposit in the Tete Juan Cache section, which has its natural outlet through the North Thompson Valley. Being thus interested, I found your descriptive article on the product and use of mica very interesting. This must be my apology for intruding on your valuable space, to make known to your readers the fact, that, in British Columbia there is a wonderful deposit of mica. These deposits are tremendous when considered alongside of those described in your December number, both in respect to the extent of the area, size of clear sheets, transparency, texture, flexibility, etc., etc., having, as far as investigation has gone, all the requisite elements required in the use and manufacture of all the innumerable articles for which that mineral is now being utilized, at the same time devoid of a great deal of the disabilities to which this particular mineral is subjected in other parts. The existence of mica in the Canoe River and the Tete Juan Cache region, was known to the Indian trappers of the upper reserve of the North Thompson for a good many years before they imparted their knowledge to anyone outside of the tribe. About five years ago a couple of them brought out a few samples and showed them to the Indian Agent at Kamloops. He informed them that that quality of mica was valuable. This information roused their cupidity, and a high figure was set in case any speculator should turn up with a desire to secure the mineral. Through one means and another, L. V. Bennett got on to the find and made a bid, which was even larger than the Indians had any hope of getting. He was consequently taken up. An expensive expedition was fitted out, the mines were visited and several locations secured. Not being a practical man, considerable money and time have been expended to no great purpose. I took over the management of the property in December, 1893, and visited the localities during the past summer in company with two experienced miners. I was surprised to find such an extensive mica bearing area, in fact, instead of finding deposits of mica, I found veins of well defined leads of spar quartz, perfectly impregnated with Mica. At Canoe river I found what I have been pleased to term a doubtful ledge, in which fair sized sheets could be had, at least five miles from where the mammoth veins are exposed, in an embraced area of from two and a half to three miles square. The veins run south-east and north-west in well defined ledges, of which there are no less than twenty, varying in size from five to twenty feet across the face on the surface; from the one tested a superior quality of mica was produced, but our operation was not sufficient to determine what size blocks can be obtained, what I got was in small sheets four feet below the surface. The mineral was found to be firm, clear in transparency when stripped, tough and flexible in nature, although from the surface the elements seemed to have had no deteriorating effect, being totally void of foreign elements. On examination I found that numbers of the veins were capped to the depth of from three to four inches with smoky mica, connecting in some instances with the white mica below with no bad result.

I next visited the mine at Tete Juan Cache which is twenty miles distant, north of Canoe river, here I found even a more extensive area in which mica was imbedded. I operated on one of the veins and satisfied myself that blocks can be had from which perfect clear sheets, from two to four inches thick, that would square from 2 x 4 to 24 x 36 inches. As yet no depth has been gained on any of these veins; here we drove in under a bluff to make a face, and found the blocks had suffered more or less from slight movements of the mountains, the slight interruption produced a waste of about 30 per cent. The waste is, nevertheless, strictly confined to the blocks horizontally and those lying in any way sideling in the vein; those lying perpendicularly did not suffer in any way. I noticed also that the transparency of the mica was not in any way affected by percolation or intrusion of any foreign matter. The mica throughout is formed in felspar. Fluor spar and beryl are also found among the quartz, traces of iron is also visible. The blocks I put out were from 4 to 10 inches thick at one end, they being wedge shaped; the average weight was from 20 to 70 lbs. I brought out eight blocks, the largest 10 inches thick at one end and weighed 64 lbs. The samples brought out from the latter mine are of a perfect clear white, somewhat brittle, yet retain a flexibility that gives it toughness nearly equal to that of Canoe river. With this vast field at our door, I can see no reason why Canada through British Columbia, should not furnish the world of commerce with all the mica that will be used for an unlimited number of years. I will be much pleased to give any further information in connection with this mineral at any time should any of your readers so desire; as an important source of wealth to the Dominion it should be widely known to the commercial world.

JOHN F. SMITH.

Louis Creek P. O., B. C., 8th Feb., 1895.

LEGAL.

An Unrivalled Boomer.—S. J. Ritchie's Ambition to make Millions.—A fat Claim for Compensation.

Since our report of the celebrated action, McMullan vs. Ritchie, in the United States Circuit Court for the Northern District of Ohio, we have been favored with a copy of the decision as rendered by the Circuit Judge, the Hon. Horace H. Lurton, which gives much interesting information respecting S. J. Ritchie's *modus operandi*. The following excerpt will, we are certain, be of interest to many of our readers:— "The aggregate amount of compensation claimed by Mr. Ritchie for services of one kind or another, to one or other, or both the mining companies exceeds $1,000,000. These services may be enumerated under the following heads:— First, for buying mineral lands now owned by the Copper Company; second, for buying lands now owned by the Iron Company; third, for services rendered in getting nickel ore placed on the free list of the McKinley bill; fourth, services in the matter of extending the uses of nickel as an alloy in armor steel; fifth, services in Europe, Canada and America in advertisement of the value of the copper and nickel mines owned by the copper company, and endeavoring to bring about a sale of the product and of the property, or a consolidation with other nickel-producing mines; sixth, services in experiments tending to add to the value of the iron mines owned by the iron company; seventh, services in getting certain valuable contracts for the sale of nickel matte to the Unites States government and to Carnegie, Phipps & Co.; eighth, services in obtaining a proposition from Edison for the erection of a plant for the concentration and desulphurization of the iron ores of the iron company; ninth, services in getting certain propositions for subsidies from Canadian towns in aid of the erection of plants intended to work the ores of the iron mines; tenth, for services in getting switches put down to connect the copper mines with the Canadian Pacific Railway.

With regard to each and all of these claims, it may be said that, when Mr. Ritchie was engaged in the matters for which he now claims compensation, he was officially connected with the companies, either as an officer or director; and neither company had by any resolution or by-law provided for any salary or compensation to any president or director, and that the only salary paid for services rendered by any president or director, was a small salary paid the secretary and treasurer, Mr. McIntosh, and that the services rendered by Mr. Ritchie were voluntarily rendered, and without expectation on his part that he would be paid for them, or on the part of either company that he expected payment. There was neither an express nor implied contract upon which he can now predicate a claim for services rendered. That he expected no salary or other compensation is overwhelmingly shown by circumstances, as well as by his direct declarations, established by several witnesses. Most of his claims for services have no equitable basis whatever. For the purchase of the original tract of land containing copper ore he claims $50,000. That tract was bought by him for $14,000. It was bought for himself and Senator Payne. Ritchie took a three-fourths interest, and Payne one-fourth, each paying the purchase money in that proportion. Subsequently it was conveyed to the copper company, for the consideration of $1,000,000 in the stock of that company. This stock Ritchie thinks was then and is now worth par. This stock was issued to Ritchie and Payne, and to such other persons as they directed. Just why the copper company should now pay him $50,000 for selling to it at $1,000,000 property which cost him $14,000 does not appear. The great bulk of the mineral lands now owned by the iron company consist in a tract of 15,000 acres, in which the company owns an undivided three-fourths interest, the other one-fourth interest being owned by one Coe, who has persistently refused to sell his interest to the company. The interest the iron company owns was conveyed to it by Ritchie, Payne, and one McLaren, each of whom owned an undivided one-fourth interest; Coe, as before stated, owning the other one-fourth. For their interests, Ritchie and his co-vendors had paid some $14,000. They conveyed their undivided interests to the iron company, in consideration of $1,500,000 paid up stock of the company; $500,000 being issued to each of them. Subsequently, other lands were bought by Ritchie; sometimes in his own name, and sometimes in association with one or the other of his codefendants. Such lands were subsequently conveyed to one or other of the companies, at large valuations, for stock of the company. The terms on which these conveyances were made were always satisfactory to Ritchie as a vendor, and equally satisfactory to the corporation vendee, it being practically represented and controlled by the vendors. Just why either of the companies should now pay for such services is past finding out on this record. The demand for payment of $100,000, as the value of certain switches put in by the Canadian Pacific Railroad Company to connect the copper company's lands with their line of railway, is equally groundless. The grading seems to have been done by the copper company, the rail and ties being furnished and put down by the railroad company. His claim is that he should be paid for what the railroad company furnished and did. This he puts upon the ground that he had some special influence with the Canadian Pacific Railroad Company, and that what they did was in discharge of obligations to him. What the railroad company did was done for the copper company, and in the interest of the railway company, and for the purpose of developing business for itself. The transaction is one well known to be quite common, and the claim for the value of the track thus put down has no merit in it.

That Mr. Ritchie was extremely active and zealous in endeavoring to make a market for the nickel ores produced by the copper company, and in securing the admission of such ores into this country free of duty, and in efforts to give some value to the iron ores of the iron company by the discovery of some cheap process by which lean ores might be concentrated and deprived of the excess of sulphur which rendered them useless, is most clearly shown. That he spent his time, influence, and money under any employment by either company is not shown. On the contrary it is shown that he gave his services with no expectation of compensation, other than as the stocks owned by him in the mining companies would be enhanced in value or made saleable as a result of his efforts. Another motive moving him to do all in his power to bring about a large operation of these mining properties is found in the fact that he was the president of the railroad company extending from Lake Ontario to the iron company's lands, in the interior. That road was valueless unless it could get freight, and its chief expectation of freight was in the large operation of this iron property. Ritchie was also the owner of a majority of the bonds issued by the railroad company, and of a majority of its shares of stock. It was unable to pay interest upon its bonds. The operation of these iron mines on a large scale would, it was believed, enable it to pay interest on its bonds, and give value to its stocks. Still a stronger explanation of his willingness to aid in every way the development of both the mining companies is found in the character of Ritchie. As this record shows him, he was a man of great ability, enormous energy, and a towering ambition for great enterprises. As a promoter or "boomer" he seems to be unrivaled; a man of large general information and robust constitution, extraordinarily sanguine, desperately pugnacious, generous as a prince, and possessing no degree of caution whatever. His ambition was to make millions. He believed with all his soul that these mines were of fabulous wealth. On their development he had staked all he had and all he could borrow. Difficulties did not deter him, nor danger affright him In his mad pursuit of what he believed could be made out of these properties, he could not be restrained by his associates. His determination to dominate led him to give an amount of time to the affairs of these companies largely in excess of any duty by reason of official position. Their caution was, in his judgment, timidity and cowardice. He acted as if he owned the whole property, and, when his advice was rejected or his unauthorized contracts repudiated, he pronounced the conduct of his associates as treasonable, malicious. The court is not particularly impressed with the scrupulousness of his methods, or his reliability as to details of fact. He appears to have been an overbearing, imperious man. That such a man, owning a majority of the shares in each of these companies, should assume to represent them upon all matters of moment, and should endeavor to promote their interests in a thousand ways, is just what might be expected. That he should do so in his own interest, and by reason of his invincible desire for leadership, is precisely what we might look for. That he should wait for employment, or look for compensation when the stake was millions, we should not expect. That he should now turn round and demand pay for all this expenditure of energy, time, and influence is only explainable by the unfortunate result of all his grand schemes and heroic efforts. The conservatism of Payne, Cornell and Burke was never a barrier to his exertions, or an obstacle to his plans. He never saw difficulties in the way of the development of these properties, and their consolidation with the other great nickel mining companies of the world. To these ends he devoted himself with the zeal of a crusader. That such an unrestrainable man, of cyclonic energy, zeal, and ability, should now ask pay for each speech he made in favor of free nickel, or day spent in the laboratory of Edison, endeavoring to solve the problem of desulphurization, is wholly due to his final disappointment at results. I am quite clear that, on the whole evidence, there is no evidence which would justify a court in saying that there was an implied agreement for compensation.

What has been said as to compensation for services applies equally to his claim for $50,000, spent in the services of these companies. He admits that he kept no account of such expenses. He cannot apportion them between the several corporations, or say in what service he spent any particular sum. He had no purpose to make a charge for his personal expenses when engaged in the matter for which he now asks compensation. Some of his expenses seem to have been paid. During 1890 he was paid $1,600 on this account. His present demand is purely an afterthought, and has no just basis."

McKinnon vs. Snowden.—This appeal was heard before Justices Crease and Drake in the Division Court, Victoria, B.C., last month. The plaintiff, Alexander F. McKinnon, claims that the defendant, N. P. Snowden, has trespassed on his claim, known as the Maple Leaf mineral claim, situate in the district of Kootnay on the left side of the C.P.R. going east, about a mile and a half up the mountain from Muir tunnel. He alleges that the claim was first recorded by him in May, 1886, and he claims possession of this claim, the ejectment of the defendant, and the sum of $1,000 damages. The defendant, Snowden, denies all this, and alleges in contradiction that the plaintiff is within the railway belt, and, moreover, that the plaintiff has lost any rights he might otherwise have had owing to his non-compliance with the provisions of the Mineral Acts. In the alternative, the defendant further pleads that if the plaintiff had any claim to the mine, it was an adverse claim, and that even that had been waived by him through his not having prosecuted such claim with due diligence in accordance with the provision of the statute, and he is, therefore, barred now from any right of action. The case came up for trial before Mr. Justice Walkem at Kamloops, who made an order making the Lanark Mining Company party defendants to the action. From this order the present appeal was brought by plaintiff. Judgment was reserved. Mr. W. J. Taylor for appellant (plaintiff); Mr. E. V. Bodwell for respondents.

Disputed Mica Title.

Supreme Court of Canada—Appeal—Dame Altha Ann Baker (Plaintiff in the Court Below) and Alexander McLelland, (Defendant and Respondent) and F. W. Webster & Co., (Mis en cause and Respondent in the Courts below).

On first November, 1877, the respondent, Alexander McLelland, by deed sold to one Stephen Wilkins, of Ottawa, all the mining rights of phosphate on the south half of lot 10 in the 14th Range of Hull, County of Ottawa, The sale was made for $25.00 in cash and upon condition that the vendor should receive a royalty of $3.00 per ton of phosphate. The deed of sale contained the following clause: "In case said purchaser in working the said mines should find some other mineral of any kind whatever, he shall have the privilege of buying the same from the said vendor, by paying the price set upon the same by two arbitrators appointed by the parties." On 16th April, 1884, Wilkins assumed to sell to Thos. Birkett the mines and mineral rights upon the lot. On 31st January, 1888, Birkett assumed to sell to W. E. Brown of Ottawa, the same property. On 19th July, 1890, Brown in turn sold to S. J. Edmonson, who again on 21st July, 1890, assumed to sell to Dame Baker, the wife of the said W. E. Brown. On 9th November, 1891, McLelland for good and valid consideration disposed to Webster the exclusive rights to mine and work all the mines or veins of mica for a term of ten years. The appellants brought their action alleging a claim of title from McLelland through Wilkins setting up the pretension that the clause referring to the right to purchase on a price to be fixed by arbitrators, covered all minerals upon the lots which were not included in the original grant to Wilkins and further alleging that mica had been discovered upon the property of great value and that the final appellant deserved to acquire the same at a price to be fixed by arbitrators, that McLelland had refused to agree upon an arbitration although duly required to do so, but had on this sold the mica rights to Webster who was then working the same, and by so doing he greatly impaired and caused damage to to the appellant.

The appellants (plaintiffs in the Court below) pray that McLelland and Webster should join with them in this arbitration to fix the price of the mica and other minerals not covered by the original grant to Wilkins and that McLelland should be compelled to pay the appellants $20,000 damage with interest.

The respondent Webster filed:— (1) A general denial. (2) That the clause cited was null and void and inoperative as regards him inasmuch as the same was inserted in the deed to Wilkins without any consideration. (3) That the stipulation did not convey to Wilkins any real rights in any minerals then existing or which might thereafter be discovered upon the lot, and that neither Wilkins nor any of the parties holding from him, ever had possession of the mica rights. That if any benefits were conveyed to Wilkins by said stipulation, which was not admitted but denied, the benefit was a personal right and privilege of Wilkins to become purchaser of the said minerals and the rights did not pass to Birkett and the others, and that no assignment as may have existed in favor of Wilkins was ever served upon or notified to the respondent McLelland or the present respondent, Webster. Also among others that the right had been extinguished by lapse of time. The judgment of the Superior Court for the District of Ottawa dismissed the action of appellant with costs, on the ground that the stipulation in question did not convey any such real right to Wilkins as the appellants were seeking to exercise and enforce in their action in the Court below, and that consequently no such pretented rights as the said appellants were so trying to exercise could be conveyed by Wilkins to Birkett and through Birkett to others. The judgment appealed from confirmed the said judgment, hence the present appeal to the Supreme Court.

MINING LEGISLATION.

NOVA SCOTIA—The Mining Society of Nova Scotia having appointed a committee for the purpose of securing, if possible, further legislation, which may be in harmony with good mining practice and the best interest of their province have issued a circular letter to members asking for their views and suggestions on the following points:—

1. Amendment to the present Mining Act. (a.) Of title and tenure; (b.) of mining regulations; (c.) of special rules; (d.) of royalty and rentals; (e.) of applications for and locations of areas; (f.) of forfeitures, etc., etc.
2. As to the general policy of the Government towards the mining industry generally as a whole. (a.) Looking to improved facilities; (b.) looking to general topographical and geological surveys of the province, and extended information of our mineral resources; (c.) looking to extension of markets for the raw products of our mines; (d.) looking to the investment of foreign capital in this industry; (e.) looking to technical mining education.
3. Generally of a policy which will look to the prosperity of the mining industry, either particularly, or as in whole.

This Society has already proved a valuable auxiliary to the Provincial Government in amendments to mining legislation, and this effort to secure the views of the representatives of the various industries is a practical measure which should secure a full and hearty co-operation of all the members.

BRITISH COLUMBIA—Several bills amending the mining laws of this province have been introduced during the present session of the local legislature, notably one respecting coal mines regulation, which seems to have provoked a good deal of discussion, both in the House and in the press. Not having seen the bill itself the REVIEW can make no comment upon it.

GOLD MINING IN NOVA SCOTIA.

From our own Correspondent.

CARIBOU DISTRICT.—The developments made on the Jack and Bell property by Capt. Mackintosh show a strong lode, well mineralized and running high in gold. A stamp mill and the necessary mining plant is being placed on the mine this winter and will be in running order by the advent of spring.

The consolidated property of the Caribou Co. is being worked chiefly in the "Dixon" mine. Some work has been done on the "Truro" mine and at other places, but without published results to date.

FIFTEEN MILE STREAM—This property has had a most favorable and wonderful report made upon it by Mr. Hermann Hampt, of Chicago, who puts a valuation of $150,000.00 upon the property. The average value of the ore milled is shown to be about $10.00 per ton.

KILLAG—Nothing is doing in this district, nor in the adjoining one of Beaver Dam.

STORMONT—Guysboro County bids fair to hold the palm for 1895 as it did for 1894. The "Richardson" leads the van in production and is running full time, with the new machinery giving great satisfaction. The vein at the eastern end of the mine has reached a width of 22 feet; at the western end it is from 7 feet upwards. This is one of the largest and most remarkable veins ever opened in the Province.

The "St. John" and "Antigonish" companies are working steadily at Johnson's Brook, Country Harbor, and are preparing to increase their outputs in the early spring.

The "North Star" mine at Isaac's Harbor remains closed down, as are also the "Palgrave" and the "Gallihar" mines.

SHERBROOKE—Returns from the Wentworth block (Stellarton Gold Mining Co.) are 279 ozs. gold from 298 tons in January.

Mr. Jas. A. Fraser has returned to Goldenville from Fifteen Mile Stream and is busy opening up and equipping the "Chicago" mine. There is much idle property in this district that would be bought and developed were it not for the inflated value set upon isolated areas and blocks by both resident and non-resident owners.

WINE HARBOR—Trustworthy information has been received that the Wine Harbor Co., (Harding *et al*) have cut the "Plough Lead" belt east of the large fault. It is reported that sinking will be commenced as soon as snow is off the ground.

COCHRANE HILL—The mine and mill at this place remain closed and idle. There is good authority for the statement that wages for some months are due and that the mill has never been taken off the contractor's hands.

OLDHAM DISTRICT.—The "Hay" lode, famous in the sixties for the large nugget it produced, has been cut about one-fourth of a mile north-west from the old workings, and yields about two feet of $6 rock.

MOOSE RIVER.—Mr. Damas Tuquoy is working here a seven ft. belt of slate which mills from $1.50 to $2.50 per ton. He is also working a small vein called the "Copper Lode," which is of higher grade.

The Moose River Gold Mining Co. of Montreal have recently had their property examined by Mr. J. E. Hardman, of Halifax, who has reported to the company upon the large body of low grade ore believed to pass through its mining areas.

WAVERLEY—There is nothing new to report from this district. The East Waverley Tunnel and the Tudor Mining Co. are the only operators running. Work has begun in the Dartmouth branch railway here and soon there will be one gold district in Nova Scotia having direct rail communication.

CENTRAL RAWDON—It is reported that the Central Rawdon Co. will reopen their mine the coming season.

COMPANIES.

Kootenay and Columbia Prospecting and Mining Co., Ltd.—During last year 40 tons of ore averaging 135 ounces of silver and 39% lead, were shipped from the Company's "Stanley" mine ; 55 tons running 165 ounces in silver and 60% lead, together with 40 tons concentrating ore were shipped from the Wellington mine. Two Worthington pumps, two Kelly's sectional boilers and an Ingersoll drill were added to the plant at the Wellington. A contract was made last month to drive a 675 ft. tunnel to tap the vein at a depth of 250 feet from surface. The engineers estimate 1,000 tons of ore in sight.

The Colonial Iron and Coal Company, Ltd. will apply for an Act of Incorporation at the next session of the New Brunswick Legislature. Authorized capital, $1,000,000. The objects of the company are to acquire and work coal, mineral and other lands in any of the counties of the Province of New Brunswick. Mr. R. G. Leckie, M.E., of Londonderry, N.S., is the proprietor.

The Dunsinane Mining Company is applying for Letters Patent under New Brunswick statutes for the purpose of acquiring and working coal and other mines in the Province of New Brunswick. The authorized capital is $50,000 in shares of $5.00. The directors are: John Whyte, manufacturer ; Robert Jardine, manufacturer ; and Sherwood Skinner, barrister, all of St. John, N.B. The office of the Company is to be at Dunsinane, King's Co., N.B.

Kootenay Hydraulic Mining Company.—Work is to be commenced at once on the foundation of a large pump to draw water from the Pend d'Orielle river for washing gravel.

The Victoria Consolidated Hydraulic Mining Co., Ltd.—An Act incorporating this Company passed its third reading of the Legislature of B.C., on 1st inst. The new Company comprises Wm. McKenzie, President of the Toronto Street Railway, Toronto ; George A. Cox, banker, Toronto ; Donald D. Mann and Thos. G. Holt, contractors, Montreal ; Wm. Wilson and F. S. Barnard, M.P., of Victoria, B.C. The authorized capital is $300,000 in shares of one dollar. Head office, Victoria, B.C. The property comprises hydraulic ground on the south side of the South Fork of the Quesnelle river and adjoining the Hop E. Tong Company on Dancing Bill Gulch, commencing at a stake placed about 20 feet north-westerly from the Hop E. Tong Company's tank, where they take water into their hydraulic pipe, thence extending in a westerly direction one mile, thence northerly one-fourth of a mile, thence easterly one mile, thence southerly one-fourth of a mile to the point of commencement, as indicated by stakes at the four corners, and which is held under a lease from the Crown, dated 6th November, 1890, for a term of twenty years at the yearly rental of fifty dollars, save and except thereout that mining ground known as the "Loo Quong Ching Tong" line claims, containing twelve acres, more or less, on Dancing Bill Gulch and which said ground was demised by the Lieut.-Gov. in Council to the Cariboo Hydraulic Mining Co., Ltd.

The Vavasour Mining Association.—This corporation, of which Mr. T. F. Nellis, Ottawa, is President, is mining mica with considerable success on lot 10 in the 12th Range of Hull, Ottawa County, Que. The property has been in operation since May, 1891, more or less actively, and has produced over 300 tons of merchantable mica. The property contains four main veins of calcite, pyroxene and phosphate running in a north north-easterly direction with a dip of 45° east. One of these veins has been followed for a distance of 1,646 ft. and averages from 3 to 4 feet. Considerable work has been done, consisting chiefly of an excavation of 200 ft. and shafts of 90 and 70 ft. with a gallery of 80 ft. The principal vein was opened for a length of over 400 ft. and several other veins in various parts of the property. At present the main vein is being worked in two places, one of which is 12 ft. wide and 70 ft. deep ; the other 10 ft. wide and 30 ft. deep, fine crystals of mica being exposed. A cutting shop has been in operation since September last year.

Similkameen Gold Gravels Exploration Co., Ltd.—The new directors of this company are :— H. Hoy, J. M. Murray, A. H. Chaldecott, H. Rhodes, T. R. Morrow, W. E. Patterson, and C. E. Hope. The property contains 667 acres on the Similkameen river and is opened by three shafts of an average depth of 30 feet, and an adit 60 feet. The average value of the gravel is from 15 to 35 cents per yard, but a portion gives as high as $1.20 per yard and even higher. Water-rights cover 5,000 inches. Operations on an extensive scale will be begun in the spring.

Le Roi Mining and Smelting Co.—The mines of this company at Trail Creek, B.C., are producing and shipping to United Smelting and Refining Co. at Helena, Montana, an average of 30 tons of ore per day. The main shaft is down 355 feet and work is being pushed on the 300 and 350 ft levels, a force of 50 men being employed. A 10 drill compressor and two large boilers have been added to the plant.

Slocan Surprise Mining Co., Ltd.—Two hundred tons of silver ore have been shipped from this company's mine in the Slocan, B.C., and 100 tons more will go forward to smelters before the spring.

War Eagle Mining Co.—Machine drills are being put into this company's gold mine at Trail Creek, B.C. A tunnel is being driven to prove the property to a depth of 300 feet.

Cariboo Gold Fields, Ltd.—This is the name of a company now being promoted in London with a capital of $100,000 to work the alluvial properties of A. D. Whittier, at Barkerville, B.C.

Ophir Mining Co. of Chicago.—Rumours of differences among the owners are rife and it is not unlikely that litigation will ensue. In his report recently issued Mr. A. Blue, Director of Mines, makes the following pertinent remarks respecting the operations of this company :— "The stock was eagerly sought after at first, and large blocks were subscribed for by Americans who visited the mine and carried away samples of the ore. Numerous assays of these samples showed it to be very rich ; but having been selected for their richness, no prudent dealer in mining stocks would consider that they represented the average ore of the vein. A mill test made at the Houghton School of Mines however, was regarded as much more reliable. Three lots treated there, aggregating 5,170 lbs. were reported to yield 9·7 ozs. of gold and 6·15 ozs. of silver. On the strength of this report sales of stock were readily made in the spring of 1893, but the financial panic which swept the United States soon afterwards caused many of the purchases to be cancelled. For this and other reasons of an administrative nature, the company has been working along under dfficulties. The mine was absurdly overstocked, and this is a too common fault in Ontario as well as elsewhere ; yet there does not appear to be any sufficient reason for doubting that it is a good gold property."

Cumberland Railway and Coal Co Ltd.—At the annual general meeting of shareholders held in Montreal this month the old board of directors was re-elected. Sales of coal in 1894 were within 6,000 tons of previous year.

Sunshine Mining Co. of Duluth—This company is making arrangements to start work on its silver claims near Ainsworth B. C. Mr. W. W. Warner, superintendent is now at the mine.

H. H. Vivian & Co. Ltd.—The following is the twelfth report of the directors :—At the commencement of the twelve months the selling-price of nickel was about 1s. 9d. per lb. net, and of cobalt about 6s. 1d. per lb., while at the end nickel had been sold as low as 1s. 3½d. per lb., and cobalt 5s. 3d. per lb., and it was necessary to reduce the value of stocks in accordance with the prices ruling at the time of taking stock. The loss on the nickel and cobalt trade of Hafod Isha Works was £15,502 10s. 7½d., of which £13,340 15s. 11d. is entirely attributable to the reduction in the value of stocks. Over such a loss no control is possible. The difference between the two sums is due to the constant fall in prices of current sales during the year. A loss of £1,299 15s. on the Murray Mine, Canada, arises from the value of the nickel product being credited at less than cost, although this mine has produced, and is producing, at a low rate. A loss of £3,764 12s. 1d. on the Evje Mine is very vexatious. When the directors took a lease of this mine the value of nickel was about 2s. 9d. per lb., at which it was capable of working profitably. The fall of nickel to prices previously mentioned upset all calculation, and converted the anticipated profit into a loss. The lease of this property has now been terminated. On the company's works at Birmingham there was a small net profit of £1,095 6s. 2d.

Bell's Asbestos Eastern Agency, Ltd., has been registered in London with a capital of £10,000 in £1 shares to enter into an agreement with the Bell's Asbestos Co. Ltd. and to carry on in China, Japan, the Straits Settlements or elsewhere, the business of purchasing, selling, and dealing in as agents or otherwise, asbestos goods and articles connected with the utilization of asbestos.

Slough Creek Mining Co. Ltd.—Messrs. Moran Bros. of Seattle, Wash., have a cotract to supply a number of pumps of special design for this company's gold property in the Cariboo district, B.C. They are so made that they can be raised and lowered in the shaft, or attached to the sides as required. Two pumps are joined together, with an eight inch suction and six inch discharge, placed between the two ; but they can be worked indipendently. The machime is held in suspension by steel cables attached to hooks on the top, but it can be made stationary to the side of the shaft with steel clamps attached to the side. These two twin pumps have a combined capacity of one thousand gallons per minute, and with the pump now in place the mine will possess a pumping plant of 1,250 gallons per minute. This is more than sufficient to take care of any water that may be met with. The contractors were determined, however, to place themselves in a position to meet any emergency, so that any further delay in driving towards bed rock would not occur. Arrangements have been made with the founders so that duplicates of any parts which might become broken can be ordered by wire.

Dominion Coal Co., Ltd.—By courtesy of the management we are able to give below the returns of the various collieries operated by this company during the twelve months ended 31st December :—

	Coal raised.	Coal shipped.
Gowrie	138,286 tons.	127,018 tons.
Reserve	223,079 "	209,343 "
Old Bridgeport	54,842 "	54,656 "
Glace Bay	144,341 "	137,567 "
Victoria	130,962 "	120,647 "
Caledonia	125,124 "	118,872 "
International	138,190 "	127,205 "
Dominion No. 1	33,346 "	33,776 "
	988,170	929,084

Recapitulation.

Shipped	929,084 tons.
Land sales	2,644 "
Collieries	43,849 "
Employees	14,490 "
	990,067

The intention of the contractors is to at once put on two ten-hour shifts, so that the work of sinking and running a tunnel will proceed night and day. For the past couple of months a number of men have been engaged in cutting fuel and sawing lagging for timbering the shaft and tunnels, the company having their own sawmill for this purpose, so that in reality work has not been stopped at the mine at any time during the past year. The present drain tunnel is to be extended from a point three hundred feet below the shaft for a distance of four hundred feet across Slough creek to the rim rock at the mouth of Nelson creek. The boring machine proved that this bench of shallow bed-rock extended over four hundred feet fiom the mouth of Nelson creek to where the channel of Slough creek suddenly dips to the 245-feet depth. The gravel between the surface and the shallow bed-rock has been proved by prospecting to contain a large amount of gold. A shaft will be sunk from the surface at a point where the drain extension strikes the rim-rock, and be continued to the old channel if necessary.

Creighton Gold Mining Co., Ltd.—A meeting of the shareholders of this Company was held at the offices of the Company, Ottawa, on 18th inst., when Mr. J. Burley Smith, M.E., presented his report of recent boring with diamond drill on the Company's property at Sudbury. The following officers were elected for the ensuing year :—E. Seybold, *President ;* F. P. Bronson, *Vice-President ;* Hon. E. H. Bronson, G. B. Pattee, J. R. Gordon, W. D. McPherson, W. A. Clark, Wm. McGillivray, *Directors ;* A. W. Fraser, *Secretary-Treasurer.*

Fraser River Mining and Dredging Co., Ltd.—A sale of stock, by auction, was held at Vancouver on 11th instant. There was a large attendance and keen competition, the entire block, consisting of 300 shares, being knocked down to Alderman Coupland, at $2.10 per share, the highest figure yet realized for this Company's stock.

The Lillooet, Fraser River, and Cariboo Gold Fields, Ltd.—The prospectus of this concern has been issued on the London market. The authorised capital is £50,000 in shares of £1, of which £32,500 was offered for subscription, the remaining £17,500 being paid for the properties. The directors are :— Mr. F. S. Barnard, M.P., (Member of Dominion Parliament for Cariboo District), Victoria, British Columbia ; Mr. A. E. McPhillips, Q.C., Victoria, British Columbia ; Mr. Charles T. Dunbar, Lillooet and Vancouver, British Columbia (mine-owner) ; Mr. Reginald Northall-Laurie, 57, Sloane Gardens, London, S.W. ; and Mr. E. C. Robson, 8, Austinfriars, London, E.C. The directors will hold a qualification of £1,000 or 1,000 shares each, and will give their services to the company, without remuneration, until the shares are receiving a dividend of 20 per cent. per annum, when they will divide 5 per cent. on dividends paid in excess of that amount. The following are the descriptive paragraphs of the prospectus :

This company has been formed to acquire and develop gold claims in British Columbia, and, in particular, to acquire and work the gold deposits in five claims at and about the village of Lillooet, Fraser River, known as the Irving, Jensen, Macdonald and Hurley, Robson, and Welton claims.

The Canadian Pacific Railway is now at its station at Lytton, within 42 miles of the properties, and from its station at Ashcroft there is a capital government stage road to Lillooet, 65 miles. This removes the principal difficulty which has hitherto retarded the development of the celebrated Fraser River Goldfield, where since 1858 thousands of hand-washers have been at work, although the difficulties of transportation were such that for years the original cost of commodities was scarcely considered, and flour, tobacco and nails were worth the same price per pound. The lands are held under perpetual leases direct from the Crown, and comprise altogether about 480 acres. The attention of the directors was drawn to these properties some two years ago by the good results obtained in these alluvial gold fields by the most primitive methods of working. The Macdonald and Hurley claim was shown by official certificates to have yielded a good return to these primitive methods. This is supported by the certificates of the following gentlemen :

Mr. A. W. Smith, Member Provincial Parliament, obtained from 1890 to 1893 £1,135.

Mr. C. A. Phair, Government Mining Recorder, obtained from 1890 to 1893 £145.

Mr. Angus Beaton certifies that in six months work, and with only 200 inches of water, he obtained in 1893 £1,340 from this claim.

With these facts before them the directors despatched Mr. R. C. Campbell-Johnston, a gold mining engineer of long and varied experience, to the place, to make a report upon these properties. His report is inclosed with the prospectus. It will be observed that he has driven the ground in the Macdonald and Hurley claim for 40 ft., and has found that it averages 25 cents per cubic yard, and that this rich gravel measures on the Macdonald and Hurley Claim alone 10,000,000 cubic yards.

It will be observed from Mr. Campbell-Johnston's report, that his estimate of 25 cents per cubic yard is confirmed by actual results obtained on the Macdonald and Hurley Claim, which has yielded 7,000 dollars worth of gold from 30,000 cubic yards of gravel—that is, 23 cents per cubic yard. For effective working a full supply of water is necessary, and the directors, under the advise of Campbell-Johnston, intend to bring water from Cayoose Creek, as shown in the map which accompanies the prospectus, at a cost of about £23,000. This would deliver 2,000 miners inches of water on the claims, and would allow 1,250,000 cubic yards of gravel to be moved annually. The estimated cost of treating such a large amount is 3 cents per cubic yard. This would allow a profit of 20 cents per cubic yard of gravel, and this on 1,250,000 yards of gravel would give a profit of £50,000 per annum. The directors have decided to make a public company of this in order to obtain the necessary funds to lay down a pipe-line to deliver 2,000 miner's inches of water, to enable them to obtain these profits ; and 5,000 miner's inches of water have been secured and recorded with the Government so that at any time the pipe-line may be duplicated, and the profits more than doubled. The whole of the capital subscribed by the public will be applied to this purpose, or to the purchase of further claims.

The directors have secured the services, as manager, of a gentleman of undoubted responsibility and position, and long and eminently successful experience of mining business, at a salary of £200 per annum, and £100 for every 1 per cent. of dividend paid in excess of 10 per cent.

The price at which the Company acquires these properties is £17,500, the vendors taking the whole amount in shares.

The directors are personally interested in the sale of the property—that is to say, they receive £17,500 in fully paid shares, and they pay to the original owners of the claims £9,750, namely, £2,000 in cash and £7,750 in shares. The directors have also expended, in having the mine examined and reported upon, some £1,750 ; so that, in consideration of their time, trouble and risks in consolidating and thoroughly testing the claims, their joint profit is £6,000 in shares.

The only contracts entered into are between John Irving and Archibald Macdonald and Daniel Hurley as and for the vendors, and Robert Horne-Payne for and on behalf of the Company, dated Victoria, British Columbia, September 15th, 1894, whereby the vendors severally agree to sell the above mentioned mining claims and water privileges for the consideration of £17,500 in fully paid shares.

These agreements, and full reports, certificates, maps, etc., and all other particulars may be inspected on application at the office of the Company.

Mente et Malleo.

DEDICATED TO THE LOGAN CLUB.

By thought and dint of hammering
Is the good work done whereof I sing,
And a jollier lot you'll rarely find,
Than the men who chip at earth's old rind,
And often wear a patched behind,
By thought and dint of hammering.

All summer through we're on the wing,
Kept moving by the skeeter's sting ;
From Alaska unto Halifax.
With our compass and our little axe,
We make our way and pay our tax,
By thought and dint of hammering.

We crack the rocks and make them ring,
And many a heavy pack we sling ;
We run our lines and tie them in,
We measure strata thick and thin,
And Sunday work is never sin,
By thought and dint of hammering.

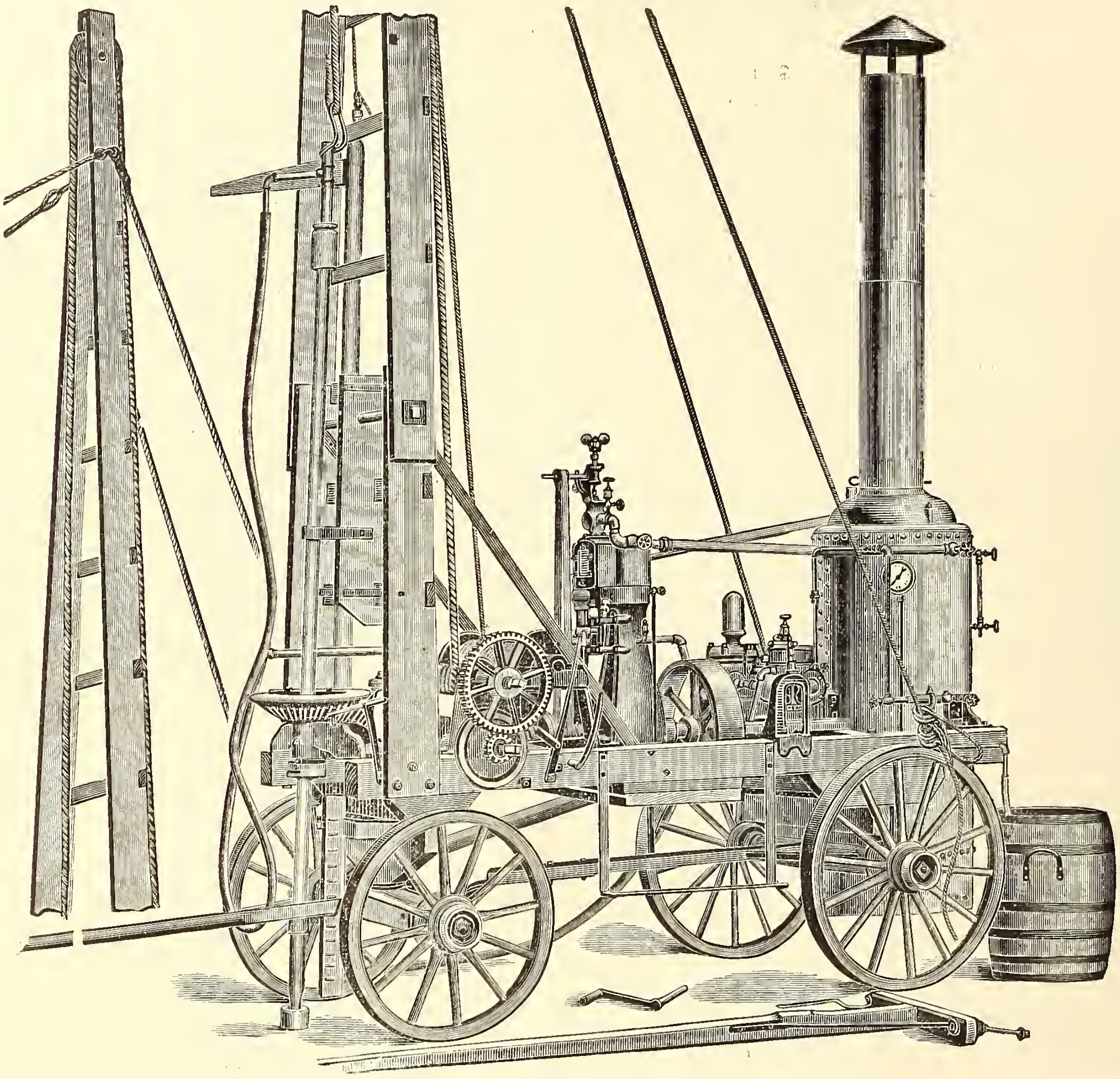
Across the waters our paddles swing,
O'er wind and rapids triumphing ;
Thro' mountain passes our slow mules trudge
As if they owed us a heavy grudge
And often can't be got to budge,
By thought and dint of hammering.

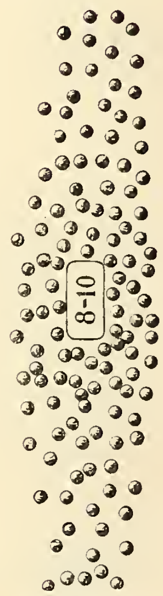
To the stars at night our thoughts we bring
But no maiden fair to our arm doth cling ;
She, at Ottawa, with smiling lips,
The other fellow's ice cream sips ;
You can't prevent these feminine slips
By thought and dint of hammering.

To array the "chiels that waunna ding"
Is our winter's work far into spring ;
Some people think us wondrous wise ;
Some maintain we're otherwise ;
We're simply piercing Nature's guise
By thought and dint of hammering.

—A. C. L.

Peat Bogs as Electric Stations,—The peat bogs of the United Kingdom are roughly estimated by Mr. P. F Nursey at 6,000 acres, having an average depth of 12 ft., and being capable of yielding 3,500 tons of dried peat per acre. In Ireland there are 2,830,000 acres, or nearly one-seventh of the entire area of the island. More than half of the Irish peat is of the best quality, and, reckoned at one-sixth the value of coal, the total supply in Ireland is thought to be equivalent to 470,000,000 tons of coal. Here is a vast store of energy, points out Mr. J. Munro, which, like the power of Niagara, may be converted into electricity and applied to many industries—especially those of manufacturing various possible products from the peat itself—in factories established near the bogs. Neighbouring towns, moreover, could be lighted from the dismal moors, and railways worked.





SHOT

PROVINCE OF NOVA SCOTIA.

Leases for Mines of Gold, Silver, Coal, Iron, Copper, Lead, Tin

—AND—

PRECIOUS STONES.

TITLES GIVEN DIRECT FROM THE CROWN, ROYALTIES AND RENTALS MODERATE.

GOLD AND SILVER.

Under the provisions of chap. 1, Acts of 1892, of Mines and Minerals, Licenses are issued for prospecting Gold and Silver for a term of twelve months. Mines of Gold and Silver are laid off in areas of 150 by 250 feet, any number of which up to one hundred can be included in one License, provided that the length of the block does not exceed twice its width. The cost is 50 cents per area. Leases of any number of areas are granted for a term of 40 years at $2.00 per area. These leases are forfeitable if not worked, but advantage can be taken of a recent Act by which on payment of 50 cents annually for each area contained in the lease it becomes non-forfeitable if the labor be not performed.

Licenses are issued to owners of quartz crushing mills who are required to pay Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at $19 an ounce, and on smelted gold valued at $18 an ounce.

Applications for Licenses or Leases are receivable at the office of the Commissioner of Public Works and Mines each week day from 10 a.m. to 4 p.m., except Saturday, when the hours are from 10 to 1. Licenses are issued in the order of application according to priority. If a person discovers Gold in any part of the Province, he may stake out the boundaries of the areas he desires to obtain, and this gives him one week and twenty-four hours for every 15 miles from Halifax in which to make application at the Department for his ground.

MINES OTHER THAN GOLD AND SILVER.

Licenses to search for eighteen months are issued, at a cost of thirty dollars, for minerals other than Gold and Silver, out of which areas can be selected for mining under lease. These leases are for four renewable terms of twenty years each. The cost for the first year is fifty dollars, and an annual rental of thirty dollars secures each lease from liability to forfeiture for non-working.

All rentals are refunded if afterwards the areas are worked and pay royalties. All titles, transfers, etc., of minerals are registered by the Mines Department for a nominal fee, and provision is made for lessees and licensees whereby they can acquire promptly either by arrangement with the owner or by arbitration all land required for their mining works.

The Government as a security for the payment of royalties, makes the royalties first lien on the plant and fixtures of the mine.

The unusually generous conditions under which the Government of Nova Scotia grants its minerals have introduced many outside capitalists, who have always stated that the Mining laws of the Province were the best they had had experience of.

The royalties on the remaining minerals are : Copper, four cents on every unit ; Lead, two cents upon every unit ; Iron, five cents on every ton ; Tin and Precious Stones ; five per cent. ; Coal, 10 cents on every ton sold.

The Gold district of the Province extends along its entire Atlantic coast, and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the Counties of Cumberland, Colchester, Pictou and Antigonish, and at numerous points in the Island of Cape Breton. The ores of Iron, Copper, etc., are met at numerous points, and are being rapidly secured by miners and investors.

Copies of the Mining Law and any information can be had on application to

THE HON. C. E. CHURCH,

Commissioner Public Works and Mines,

HALIFAX, NOVA SCOTIA.

THE DOMINION WIRE ROPE COMPANY, LTD.

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Manufacturers of 'LANG'S PATENT WIRE ROPE.

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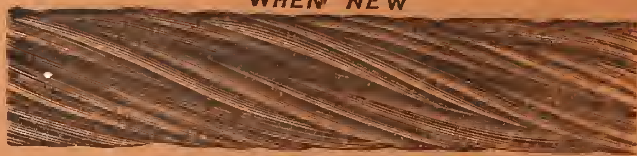

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Also Ropes for Hoisting, Mining, Elevators, Ship's Rigging and Guys, Etc., Etc.

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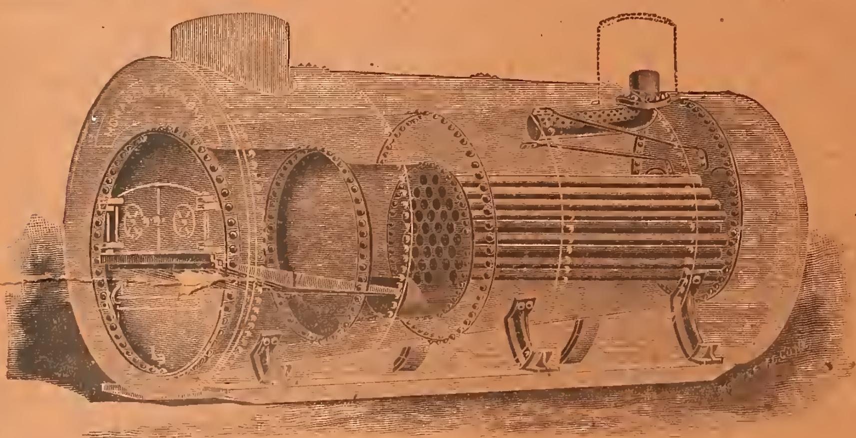

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And are guaranteed to save 10 per cent. in fuel over any brickset boiler; in some cases the saving has been as high as 30 per cent.

We also build Lancashire and the ordinary Brickset Boilers, or any other usual type.

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STEAM, GAS and DOMESTIC COALS of HIGHEST QUALITY

Carefully prepared for Market by improved appliances, either F.O.B. or Delivered.

It is also prepared to enter into Contracts with Consumers covering a term of years. Its facilities for supplying Bunker Coals with promptness is unequalled.

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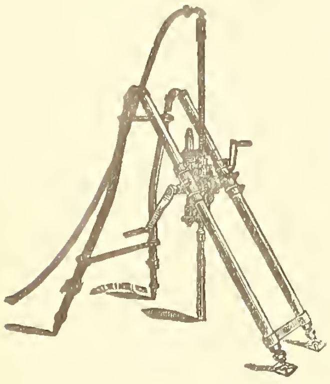

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Capacity—300 ft. depth.

Removes $1\frac{3}{16}$ inches solid core.

DIAMOND DRILLS
FOR
PROSPECTING MINERAL LANDS.

The Sullivan Diamond Drill is the **simplest, most accurate,** and **most economical** prospecting drill for any kind of formation, hard or soft, in deep or shallow holes.

The Diamond Drill brings to the surface a **solid core** of rock and mineral to any depth, showing with **perfect accuracy** the nature, quality and extent of the ore-bearing strata, and with great **saving in time and expense** over any other method.

Complete stock of all sizes, driven by hand or horse power, steam, compressed air or electricity. For sale by

SULLIVAN MACHINERY COMPANY,

Successors to DIAMOND PROSPECTING CO., 54 & 60 N. Clinton St., CHICAGO, ILL., U.S.A.

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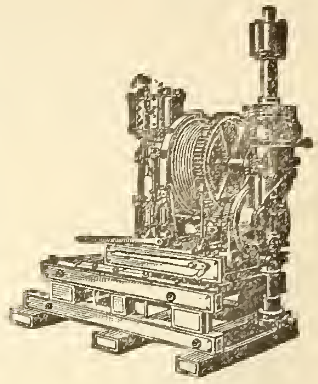
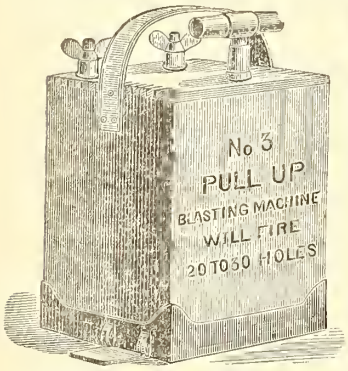
Sullivan Diamond Prospecting Drills, Channelling Machines, Rock Drills, Hoists and other Quarrying Machinery.
Hoisting and Hauling Engines, Cages, Tipples, and other Coal Mining Machinery.
Contractors for Prospecting Mineral Lands with the Diamond Drill.



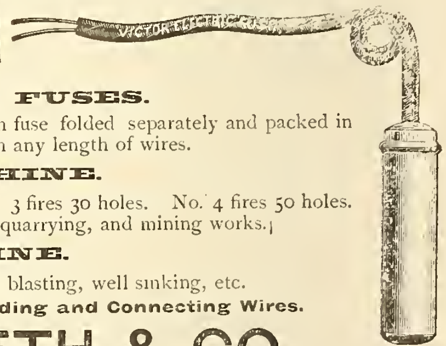
"N" Drill—

Capacity—2,000 ft. depth.

Removes $1\frac{1}{4}$ inches solid core.



ELECTRIC BLASTING



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Superior to all others for exploding any make of dynamite or blasting powder. Each fuse folded separately and packed in neat paper boxes of 50 each. All tested and warranted. Single and double strength, with any length of wires.

"PULL-UP" BLASTING MACHINE.

The strongest and most powerful machine ever made for Electic Blasting. No. 3 fires 30 holes. No. 4 fires 50 holes. No. 5 fires 100 holes. They are especially adapted for submarine blasting, large railroad quarrying, and mining works.

VICTOR BLASTING MACHINE.

No. 1 fires 5 to 8 holes; weighs only 15 lbs. Adapted for prospecting, stump blasting, well sinking, etc.

Standard Electric Fuse and Blast Tester, Wire Reels, new design. Leading and Connecting Wires.

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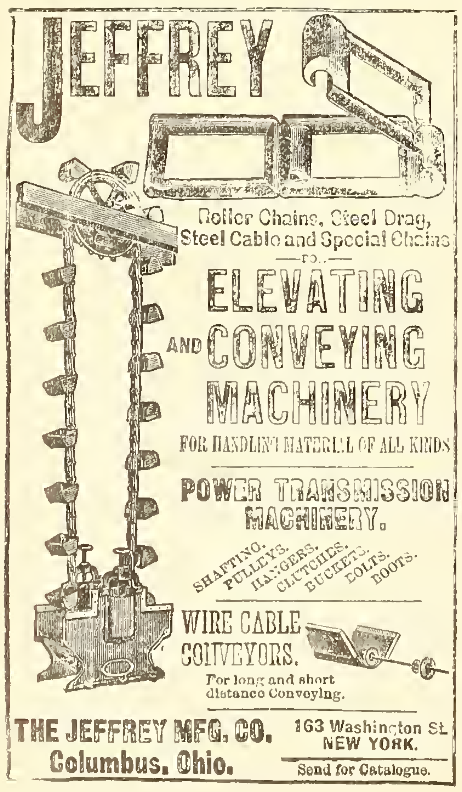

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MINING LAWS OF ONTARIO.

ANY person may explore Crown Lands for minerals.
Mining lands may be taken up as surveyed locations or staked claims.
Locations range from 40 to 320 acres.
Claims range from 10 to 20 acres on vein or lode.
Locations may be acquired in fee or under leasehold.
Price of locations north of French River, $2 to $3 per acre, and south of it, $2 to $1.50, according to distance from railway.
Rent of locations first year 60c. to $1 per acre, and subsequent years 15c. to 25c. per acre.
Rent of claims, $1 per acre each year.
Claims must be worked continuously.
Royalty on ores specified in the Act, 2 per cent. of value at pit's mouth less cost of labor and explosives.
Royalty not charged until seven years from date of patent or lease, nor (as provided in s. 4 (3) of the Mines' Act, 1892), until fifteen years in the case of an original discovery of ore or mineral.
Original discoverer of ore or mineral on claim entitled to stake out a second claim.
Crown Lands sold under provisions of mining laws in force prior to 4th May, 1891, exempt from royalty.
Copies of the Mines Act, 1892, Amendment Act, 1894, may be had on application to

ARCHIBALD BLUE,
Director Bureau of Mines

TORONTO, May 25th, 1894.

CONDITIONS
OF
Obtaining Government Drill to Explore Mines or Mineral Lands.

Owners or lessees of mines or mineral lands in Ontario may procure the use of a Government Diamond Drill, subject to the provisions of the Rules and Regulations relating thereto, upon giving a bond for payment to the Treasurer of the Province, of costs and charges for (1) freight to location, (2) working expenses of drill, including labor, fuel and water, (3) loss or breakage of bits, core lifters and core shells, (4) wear or loss of diamonds, (5) other repairs of breakages and wear and tear of machinery at a rate per month to be estimated, and (6) an additional charge of $50 per month after the mine or land has been shown, through use of the drill, to be a valuable mineral property.

Of the aggregate of costs and charges above enumerated, excepting the sixth item, forty per cent. will be borne by the Bureau of Mines in 1894, thirty-five per cent. in 1895, thirty per cent. in 1896, and twenty-five per cent. in each year thereafter until the end of 1900. All accounts payable monthly.

For Rules and Regulations *in extenso* governing the use by companies and mine owners of Diamond Drills, or other information referring to their employment, application may be made to ARCHIBALD BLUE, Director of the Bureau of Mines, Toronto.

A. S. HARDY,
Commissioner of Crown Lands.

Toronto, October 17, 1894.

The Canadian Mining Review
Established 1882

Official Organ of The Mining Society of Nova Scotia; The General Mining Association of the Province of Quebec The Asbestos Club; and the Representative Exponent of the Mineral Industries of Canada.

B. T. A. BELL, Editor. Published Monthly. OFFICES: Victoria Chambers, Ottawa.

VOL. XIV., No. 3 MARCH, 1895. VOL. XIV,, No. 3

Our Gold Mines.

For some months past our English and foreign exchanges have been filled with accounts of the boom which South African and Western Australian gold mines have enjoyed upon the London and Paris markets.

Since the decline of silver every mine must have a golden lustre before it is acceptable to the promoter, and it appears extremely probable that the coming summer will see a development of the world's gold fields quite unprecedented.

In this attraction of capital to gold mine investments it is altogether certain that the gold fields of the Dominion will share. Those of British Columbia, for a year or more, have attracted much attention and are now in a most promising state of development. Nova Scotia, from recent reliable reports, has developed a more lasting attraction for capital than her rich narrow veins have hitherto possessed, and we are informed, on good authority, that British capital is now investigating that province's resources in the line of low grade gold ores. But we hear nothing of any new attempt to open the resources of Quebec, although the vexing matter of titles has now been straightened out and no obstacle is apparent to the systematic exploration and exploitation of the many alluvions and quartz reefs of that province.

Much fruitless (because ignorant and incompetent and misdirected) work was done in the valley of the Chaudiere and tributaries some twenty to thirty years ago; yet hardly fruitless either, as the report of Mr. Obalski, Government Inspector of Mines, shows that over $2,000,000 has been obtained from a very small area in the district mentioned.

We have heard several competent engineers, who have made short trips through the County of Beauce, express very favorable opinions as to the probability of very remunerative mines, both of quartz and of gravel, being found there. The views of these engineers have of necessity been usually confined to the particular properties professionally examined, and leave room for a comprehensive and thorough report upon the field as a whole. While thoroughly appreciating the accuracy and value of the work performed in early days by Dr. Sterry Hunt and M. Michel we think that what is needed for the development of Quebec's gold industry is the examination of her gold fields, from an economic point of view, by a thoroughly practical as well as scientific mining engineer, who could report as to the remunerative character, or otherwise of the various gravels and quartz reefs which have been more or less developed since the time of Messrs. Hunt and Michel. The provincial government could not bring its gold fields to the attention of capitalists in a better manner than through the report of such an engineer.

Ontario's gold fields are yet young, with the exception of the Madoc and Marmora field, which has proved so far too refractory to extract a profit. Considerable attention has been directed to the Lake of the Woods and later to the Rainy River district, and what we have said of a report for Quebec will apply, in a measure, to Ontario, although the latter province, as yet, stands in no such crying need of thoroughly competent advice as does Quebec.

EN PASSANT.

The second annual meeting of the Ontario Mining Institute will be held in the School of Practical Science, Toronto, on Wednesday and Thursday, 10th and 11th April. A number of interesting papers are on the syllabus for discussion, in addition to the election of office bearers, and other proceedings incidental to an annual gathering.

Now that Federation has been approved of on lines agreeable to all the Canadian mining organizations, a united meeting at Quebec in July is in order. Doubtless this will receive full consideration at an early meeting of the council of the General Mining Association of the Province of Quebec.

There is a slight improvement in the demand for Canadian phosphate and 80% has gone up a penny, last quotations being at eight pence.

Our last issue had gone to press before the announcement was received of the sudden demise of Mr. William Routledge, mining engineer, of Sydney. Mr. Routledge was a member of the Board of Examiners of Cape Breton, and with his associates, Messrs. Henry Mitchell, of Old Bridgeport, and A. B. McGillivary, of Little Glace Bay, was en route for Stellarton, where they were to attend a meeting of the board. When the train was approaching the Grand Narrows, where a stoppage of twenty minutes is made for breakfast, the three gentlemen were sitting in the smoker of the "sleeper," when Mr. Mitchell noticed Mr. Routledge falling from his seat, apparently in a faint. Mr. Mitchell leaned forward and caught him in his arms, and with assistance laid him on the lounge, when it was found that life was even then extinct. Mr. Routledge has for some years suffered from heart disease, which was undoubtedly the immediate cause of death. Mr. Routledge was a brother of Mr. Walton Routledge, of Alton, Ill., late State Inspector of Mines for the Fourth District of Illinois. He was born at Durham, England, in 1829, and was, therefore, in the 66th year of his age. He was a graduate of the School of Mines, England, and went to Nova Scotia about thirty years ago as manager of the General Mining Association's Colliery at Lingan and continued in that position for ten years when he removed to the Gardiner mine; he was afterwards manager at the International, and later at the Reserve collieries. For several years he has lived at his private residence, "Colby," a beautiful villa in the suburbs of Sydney. Mr. Routledge leaves a wife and five sons, and of the latter, two are in the employ of Dominion Coal Company, one is engaged in mercantile pursuits at the mines, a fourth is inspector of the mounted police at Regina, N.W.T., and another is in Chicago.

Mr, M. Davys has been appointed manager of the Silver King mine operated by The Hall Mines, Ltd, vice Jordan resigned.

Mr. A. Dick, manager of the Canada Coals and Railway Co., Ltd., has the heart-felt sympathy of a wide circle of mining associates in the sore bereavement of his young wife, which occurred somewhat suddenly on 14th instant.

Mr. E. Gilman, secretary and manager of the Ingersoll Rock Drill Co. of Canada, has returned somewhat benefitted in health from a brief sojourn in the Southern States.

Mr. David McKeen, M.P., resident manager of the Dominion Coal Co., Ltd., and Mr. H. S. Poole, general manager of the Acadia Coal Co., are expected home this month, both we trust, rejuvenated and generally improved in health by their holiday on the Mediterranean.

The report for the past year of the Illinois Steel Company affords convincing proof of the hardness of the times in the United States. The net cost of the Illinois Steel Company's works, plant, &c., is $17,459,794, and its total capital $31,943,648, or about £6,388,000. The net profit on the year's trading after paying interest on bonds, was $30,607 ; deducting which amount from the previous year's deficit, there is left a net deficit of $318,865. The convertible assets of the company are set down at $11,643,126, which is in addition to the company's five plants and their railway securities. The company "received during the year 2,339,370 tons of raw material ; shipped during the year 563,446 tons of finished product ; total number of cars of material handled was 88,793 ; paid in wages and salaries, $3,071,394.95 ; employed an average number of men per day of 5,069 ; purchases of miscellaneous stores and supplies, other than raw material, amounted to $665,794.28." These are big figures, but the result shows that in 1894 the game certainly was not worth the candle.

It is recorded that a police constable on duty in a public museum was once overheard making zealous reply to a visitor of an enquiring turn of mind, who had asked the meaning of the word corundum, conspicuous upon a case of minerals ; "Oh, that be the place where they put all them stones as they can't guess at." Though inaccurate as an indication of the habits of museum curators, this definition might well refer to the riddle relating to this very mineral which museum curators and others will, unless we are greatly mistaken, be soon called upon to read.

The artificial rubies made in Paris a few years ago by Messrs Frémy and Feil were regarded as scientific curiosities. But, says *Natural Science*, stones are now being largely sold (it would be very interesting to know how largely) in London and elsewhere which, while closely resembling in all essential respects the rubies of Burma, are undoubtedly of artificial origin. Tried for hardness, specific gravity, lustre, and subjected to all the tests which are usually applied to precious stones, they cannot be distinguished from the natural ruby ; this is not surprising, for they are not, like other artificial stones, different from what they profess to be, but are actually crystallized red allumina, only differing from the natural ruby in the process by which they have been produced. Examined with the microscope they betray their origin by the glassy enclosures which they contain and sometimes by a streaky appearance.

Yet, adds our contemporary, it would be difficult to assert that these are not rubies, unless, indeed, the definition of a ruby be understood to include of necessity a natural origin. Considering, however, the enormous prices paid for Burmese rubies, it is certainly not fair that mere imitations should pass as such. If their beauty as jewels be equal to that of the true ruby, let them by all means fetch as high a price as they deserve on their own merits ; but we cannot refrain from speculating as to their market value if they were labelled "Made in Paris." According to French law it has been decided, we believe, that a ruby is certainly not a ruby when it is made in a crucible.

The annual meeting of the Asbestus club for the election of officers and other business will be held at an early date ; probably next month.

FOURTH ANNUAL MEETING

OF THE

Mining Society of Nova Scotia.

New Members. Federation ammendments adopted. Valuable papers read and discussed.

The fourth annual meeting of the members of the Mining Society of Nova Scotia was held in the rooms of the Society, Halifax, on Wednesday 13th instant. The proceedings opened at 10 a. m., the President Mr. John E. Hardman, S. B., M. E. in the chair. Among others present were noticed :—

Mr. R. H. Brown, Gen. Min. Ass'n., Old Sydney Mines C. B.
Mr. Wm. Blakemore, Dominion Coal Co. Ltd., Glace Bay C. B.
Mr. J. T. Burchell, Cape Breton Colliery, New Campbellton C. B.
Mr. Chas. Fergie M. E., Intercolonial Coal Co., Westville N. S.
Mr. F. S. Andrews, Richardson Gold Mining Co., Country Harbor N. S
Mr. M. R. Morrow, Dominion Coal Co., Halifax.
Mr. B. C. Wilson, East Waverly Tunnel Co., Waverly N. S.
Mr. Graham Fraser, Nova Scotia Steel Co. Ltd., New Glasgow.
Mr. Duncan McDonald, Truro F. & Machine Co., Truro.
Mr. Geoff. Morrow, Stairs Sons & Morrow, Halifax.
Mr. A. C. Ross, Boston & Nova Scotia Coal Co., North Sydney C. B.
Mr. R. G. E. Leckie, Torbrook Iron Co., Torbrook.
Mr. J. Leckie, Torbrook Iron Co., Torbrook.
Mr. George Stuart, M.E., Truro.
Mr. W. A. Smith, Windsor Foundry & Machine Co., Windsor.
Mr. J. D. Sword, Ingersoll Rock Drill Co., Halifax.
Mr. C. E. Willis, Canadian Rand Drill Co., Halifax.
Mr. Joseph Austin, Austin Bros., Halifax.
Mr. F. H. Mason F. C. S., Truro.
Mr. A. Dick C. and M. E., *The Critic*, Halifax.
Mr. W. G. Matheson, Matheson & Co., New Glasgow.
Mr. James Baird, Joggins Mines, N. S.
Mr. John Anderson, Musquodoboit Harbor, N. S.
Dr. E. Gilpin, Jr., Deputy Commissioner and Inspector of Mines, Halifax.
Dr. Martin Murphy, C.E., Halifax.
Mr. A. McQuarrie, Cochran Hill Gold Mining Co., Halifax.
Mr. A. A. Hayward, Golden Lode Mining Co., Mount Uniacke.
Mr. Chas. Starr, Halifax.
Mr. H. W. Johnstone, Halifax.
Mr. H. M. Wylde, Halifax, Secretary-Treasurer.
Mr. B. T. A. Bell, Ottawa, Hon. Secretary.

The minutes of the previous meeting having been read and confirmed,

New Members.

The following members were elected :

Mr. A. C. Ross, Boston and Nova Scotia Coal Co., North Sydney,
Mr. W. A. Saunders, Lake Lode Gold Mine, Caribou.
Mr. W. B. Ross, Q.C., Halifax.
Mr. John W. Stairs, Halifax.
Mr. H. W. Johnstone, Jr. Halifax.
Mr. Hugh D. McKenzie, Intercolonial Coal Co., Halifax.
Mr. W. C. Brine, Halifax.
Mr. E. G. Kenny, Halifax.
Mr. Wilbur L. Libbey, North Brookfield.
Mr. George A. Pyke, Halifax.
Mr. A. M. Evams, Manager Gowrie Colliery, Port Morien, C.B.
Mr. C. C. Starr, Halifax.
Mr. E. Musgrave, Halifax.
Mr. Wm. Hargreave, Halifax,
Mr. B. M. Davidson, Wine Harbor.

Fedeiation Amendments Approved.

MR. H. M. WYLDE read communications from the Ontario Mining Institute and the General Mining Association of the Province of Quebec, suggesting a few amendments to the scheme of federation as reported on by the Society at its November meeeting.

MR. B. T. A. BELL- These suggested amendments practically endorse the Society's recommendations, the only differences being, (1) that while the contribution from each of the societies in the federation shall at no time exceed $3.00 per capita annually, it has not been deemed expedient to interfere with the amount of the yearly subscriptions paid by the members to their respective societies. (2) That the council of the federation shall have power to vote any renumeration it may deem necessary or expedient to the secretary-treasurer. The other recommendation respecting publications is immaterial. As stated before such a federation should be in a position to seek some assistance from the Dominion Government taking the Royal Society's annual grant of $5,000 as a precedent, and if this was secured the cost of publication to the society would be *nil*. In any event the cost would not be much greater than it is at present, the members would benefit by a larger volume of proceedings, and the federation would be well equipped to deal with legislation and other matters of federal importance. The scheme is a good one, it has been endorsed by the other societies and, I trust, will be approved and finally adopted at this meeting.

The Mining Society of Nova Scotia.

Mr. R. H. BROWN, M. E.,
General Manager, General Mining Association of London, Ltd.,
PRESIDENT, 1895-6.

MR. C. E. WILLIS—Mr. Bell's view of a Dominion grant is a good one, but in view of the elections would it not be better to let it stand over until our next meeting. If the federation should not succeed in securing this grant, we should have to contribute as our share $300. Our income is only in the neighborhood of $1,000; we pay Mr. Bell $200 for the REVIEW.

MR. B. T. A. BELL—No; $150.

MR. C. E. WILLIS—After this meeting the amount will be $200; our secretary's grant is $250; altogether $750, leaving a very small balance for operating expenses. I think, therefore, it would be better to leave the matter over.

MR. A. A. HAYWARD—I second that.

THE PRESIDENT—I think we had better settle the matter now.

MR. W. BLAKEMORE—Being conversant with the advantages federation has brought to the mining societies in England, I am heartily in favor of this proposition, I am pleased to find that the gentlemen who have thought that the time has not arrived for it, have nothing to say against the principle. The gentleman opposing it does so only on a financial ground. In that case we should ascertain if federation would increase financial liability. If to a great extent, I would vote against it, but if only to a limited extent, I do not think we should go against federation and cut down a principle which we are all agreed is a desirable one. Mr. Willis said we would lay ourselves open to a total liability of $300 per annum. That could not be exceeded. We have heard that we pay from $200 to $250 for publication at present. I would put it to Mr. Willis whether I am not right in assuming that for the sake of $50 or $100 he will oppose a principle which he would like to see carried out at a future time. We don't want to make ourselves a laughing stock. This matter has been in hand for twelve months. The committee has thrashed out all the details. Upon what ground can we honestly go to the other societies and say: "It is true we are agreed upon the principle of federation, and upon the details, but please let it stand over for twelve months longer." If we have to be at the beck and call of any government, we may possibly never get the grant. To save time, I move in amendment; "That having previously expressed its approval of the principle of federation and having through its committee negotiated a basis of federation with the mining societies of Ontario and Quebec, this meeting agrees to the proposals now submitted by the latter associations, and authorises its committee to carry this resolution into effect as from the first of January, 1896."

MR. B. T. A. BELL—I have very great pleasure in seconding the resolution.

This amendment on being put to the meeting was carried unanimously and without further discussion.

Report of the Council, 1894-5.

The Council has again the pleasure of reporting the continued success of the Society during the past year. Though the number of members has not increased since the last annual meeting, still it has not decreased, and after electing the candidates whose names come before the meeting to-day, the Society will be enabled to begin its fourth year with a membership close on one hundred. The following is a synopsis of the finances of the Society:—

STATEMENT RECEIPTS AND EXPENDITURE FOR YEAR 1894-5.

Receipts.

Subscriptions collected 1894	$812 70
do due and uncollected	130 00
To balance	71 38
	$1,014 18

Expenditure.

Balance owing, brought forward from 1893 account	$273 08
Subscriptions to Canadian Mining Review	148 23
Operating expenses, holding meetings, guests, postages, typewriting, etc., including Sydney meeting	215 45
Reporting meetings	46 50
Printing Transactions, etc	72 87
Stationary	8 05
Secretary-Treasurer, 1894	250 00
	$1,014 18

Meetings—Three general meetings have been held during the past year, the annual meeting in March and the meeting in November being held in Halifax. The July meeting in response to the kind invitation of the officers of the Dominion Coal Co., Ltd., and the General Mining Association of London, Ltd., was held in Sydney, C.B. About fifty of the members availed themselves of this kind invitation, and a most enjoyable week was spent in inspecting the workings above and below ground, of the Dominion Coal Co., Ltd., and the General Mining Association of London, Ltd., and in joining the various excursions provided by the local committee, for our entertainment, and not for our entertainment only, but also for that of our twin sister, the General Mining Association of the Province of Quebec. The Council here desire to record on behalf of the members, their great appreciation of the manner in which the party was entertained during its visit.

Transactions—The Transactions for the year are now ready. They have been published in one bound volume, and will be issued to members immediately.

Exchanges—Complete fyles of the exchanges mentioned last March can be found in the Society's rooms; a few important additions have been made.

Committees—A deputation, upon invitation of the Institute of Natural Science, again waited upon the Premier, in conjunction with the School of Art, the Historical Society and the Institute of Natural Science. The Premier, in replying, stated that any appropriation for such purpose would probably have to be a matter of legislation, and, admitting the necessity of a better housing for the Provincial Museum and Legislative Library, thought that in planning such a building, provision for accommodating the libraries and other wants of the institutions represented, might properly be considered.

The report of the Committee on Federation, appointed at the last annual meeting to consider this question, has already been submitted.

The Committee on Mining Legislation, appointed at the last meeting, are to report to-day.

The President's Address.

MR. JOHN E. HARDMAN—Following upon the precedent established by the first president of this Society, it is incumbent upon me upon retiring from the office with which you have honored me for the year past, to deliver an address.

I cannot perhaps do better than to review in a cursory manner the events of the year now closed, drawing your attention more particularly to such points as have seemed to me to be beacons of hope for the advancement of our mining industries or sign posts of hidden danger to our future prosperity.

From the report of the Council which has just been read, and from the goodly number of new members we have just elected, (and whom I desire to take this opportunity of congratulating), you will gather that we are, as a Society, in a very prosperous and healthy condition. With a membership numbering 100 embracing not only men directly interested in our mineral products, but also men of commerce more or less connected with the development of Nova Scotia's mines, it has seemed to me that the time was ripe for incorporation, and I desire to submit for your serious consideration the question of the advisability of this Society obtaining a charter that will permit it to hold property, and will make it a legally constituted body. It will be evident to all of you present today, or at any of the meetings which have been held for the last year or more, that our accomodations are entirely insufficient for our rapidly increasing library and collection, and for the increasing number of members present at every meeting. While we are under extreme obligations to the gentleman by whose courtesy we have been enabled to use these rooms for the past three years, yet, it is evident that the requirements of the Society have completely outgrown the accomodations which Mr. Gue's generosity has hitherto provided. I wonld suggest to the in-coming president and council the advisability of action on this matter.

In regard to the action of the Government upon the importation of mining machinery, the extension of the clause permitting free entry of mining machinery partially met the demands, but there is still a great lack of clearness and uniformity in the rulings of the various collectors of the Department,

In regard to the requests made of the late Hon. Premier and Sir Hibbert Tupper, in December, 1893, for the transportation of explosives over government railways and for a reduction in the duty on explosives, I am glad to say that the Government has met us in the latter request, and that we all now are enjoying the benefits therefrom, in the shape of much cheaper ammunition than formerly. I regret, however, that the Government at Ottawa have not seen fit to give us transportation of explosives over the I.C.R. In view of the rapidly approaching election the time would seem opportune for a further movement in this direction, if the Society deem it advisable.

The report of the Council deals fully with the successful inauguration of a united midsummer meeting with our great sister association, the General Mining Association of the Province of Quebec, and also touches upon the matter of federation, which has again come up to-day for your further consideration, and, I am happy to say, favorable termination.

In respect to legislation during the year, I am most happy to say that we have had nothing to meet, consider, or disapprove of; but in this connection I cannot overlook two cases which, now in court, are liable to cause serious damage to our gold mining interests if permitted to recur. In the cases of Attorney-General vs. Sheraton and Attorney-General vs. Temple, the fiat of the Attorney-General has been allowed to overide the law, practice and records of the Mines Department, and to stand as a menace against three-fourths of the titles now held in gold mining areas in this province. The certification of titles by responsible attorneys to intending purchasers is now a farce, inasmuch as a fiat from the office of the Attorney-General may upset all such certificates and put the titles into court upon the plea of any discontented person who may chance to skilfully convince the Attorney-General that he thinks he has been imposed upon.

Nor can I let this opportunity pass of alluding to what I consider one of the most important developments our gold mining industry has seen in the 30 years of its existence.

Most of you have seen, but perhaps not all of yon have grasped the full significance of the figures which are contained in the report of the Mines Department for 1894, as regards the gold industry. The average value of the 40,000 tons milled last year was only $7 per ton, and the bulk of all the rock milled was from three or four mines whose average ranged from $4.00 to $6.00 per ton and *all of which earned dividends*. Gentlemen, the true significence of these figures is that the gold mining industry of Nova Scotia has settled down to a low grade basis; that we have proved the remunerative character of these low grade mines, and that the difference between South African and Nova Scotian gold mines is a difference (economically speaking) of *degree* rather than of *kind*. No longer can the capitalist point his finger at Nova Scotia and say "It has only small veins of high grade ores". The developments in Guysboro and Halifax county mines give an effectual denial, and I regard this change as one of the most hopeful and important that the industry in this province has ever seen.

I commend this Mines Report for 1894 not only to the consideration of those of our members interested in gold, but also to our coal men, who, I think, could contribute a paper or two to onr transactions to explain to us why in one coal mine only 51 per cent. of all the labor underground is *skilled*, while in another the percentage is 87; and why in the same district, these percentages vary by 25 per cent. to 26 per cent., being 51 in one case and 77 in another.

Also, why is it that one colliery requires to burn 14 tons in order to produce 100, whereas in another colliery 100 tons are raised by burning 5 tons.

To the uninitiated either inferior quality of coal or inferior economy of plant at once is suggested as the reason, but he may be wrong, and I merely mention these figures as those which have appealed very strongly to my curiosity, and I therefore would urge the desirability of incorporating into our transactions papers representing individual practice at our collieries.

Officers and Council, 1895-6.

The Officers and Council for the ensuing year were elected as follows:—

PAST PRESIDENTS:

Mr. H. S. Poole, M.A., A.R.S.M., (Acadia Coal Co.), Stellarton, N.S.
Mr. John. E. Hardman, S.B, M.E., (West Waverly Gold Co.), Halifax.

PRESIDENT:

Mr. R. H. Brown, M.E., (Gen. Mining Ass'n of London), Old Sydney Mines, C.B.

VICE-PRESIDENTS:

Mr. Graham Fraser, (Nova Scotia Steel Co. Ltd.), New Glasgow.
Mr. Wm. Blakemore, M.E., (Dominion Coal Co. Ltd.), Glace Bay, C.B.
Mr. Chas. Fergie, M.E., (Intercolonial Co. Ltd.) Westville.

HON. SECRETARY:

Mr. B. T. A. Bell, Editor Canadian Mining Review, Ottawa.

SECRETARY-TREASURER:

Mr. H. M. Wylde, 129 Hollis Street, Halifax.

COUNCIL:

Mr. George W. Stuart, Truro,
Mr. J. D. Sword, Ingersoll Rock Drill Co., Halifax.

Mr. C. E. Willis, (Canadian Rand Drill Co.), Sherbrooke.
Mr. B. F. Pearson, Halifax.
Mr. A. Dick, Halifax.
Mr. Geoffrey Morrow, Halifax.
Mr. F. H. Mason, F.C.S., Truro.
Mr. W. G. Matheson, New Glasgow.
Mr. R. E. Chambers, Ferrona.

The Summer Meeting.

MR. B. T. A. BELL—The members of the Quebec Mining Association have arranged to hold their summer meeting at Quebec in July, when an attractive outing on the St. Lawrence is promised. Now that federation has been agreed upon, the occasion might be utilized agreeably by a united meeting, and I am quite sure our association would very heartily welcome the members of the Mining Society of Nova Scotia. I simply offer this as a suggestion for the consideration of Council.

A Curious Old Rail.

MR. BLAKEMORE—I have brought here a piece of old cast iron rail taken out of a Cape Breton mine closed for twenty three years. There is very little iron in it. It is so light that it becomes a curiosity. I will leave it for the Society's collection, and will have a portion analyzed, and also the water which has produced such an effect. I may say that all the iron in this mine has been affected similarly. It is an extraordinary offect to be produced by water.

The members re-assembled at three o'clock, the first paper being

On Surface Surveys and the Necessity of Contour Surveys the in Gold Districts of Nova Scotia.

DR. M. MURPHY.—The surface surveys in the gold mining districts of Nova Scotia have been, so far, confined to the running of, or projection of lines over the surface to determine the boundaries of gold mining areas, or blocks of areas, as they are called. When the discovery is of sufficient magnitude to warrant a survey of the blocks, or of the areas within a district being made, the Commissioner of Public Works and Mines, under whose general supervision and guidance, the laws relating to mines and minerals are observed, will send a surveyor to run lines, showing the meetes and bounds of the properties of the respective prospectors or lessees, as the case may be.

The blocks, or their subdivision into rectangular areas of 250 feet by 150 feet, are run off from a line arbitrarily selected to follow the general direction or strike of the lead or lode, as it may appear at the surface outcrop. Such has been the practice in laying off the principal gold districts. Recently, however, this practice has been altered in laying out new districts, and the line of the magnetic meridian has been adopted instead, the general strike of the auriferous slate belt along our Atlantic border, being nearly east and west, magnetic.

It is not the purpose of this paper to offer any remarks touching the present practice, so far as the adoption of base lines or the subdivision of properties is concerned. The object in view, is to point out the desirability of extendikg the work of such surveys, not beyond the district boundaries, but within them, by utilizing the work already being performed towards the greater object in making a topographical survey over each of our gold mining districts.

All mining engineers will agree that topographical maps, if properly made to represent the configuration of the surface, are of the greatest convenience and of much value in mining work where so frequently the problem occurs to follow a strike or vein over a rough undulating or broken surface, perhaps covered by drift or boulder clay, and dipping at a high angle. In locating roads, planning drainage works, utilization of water power and some other purposes, they are also of much value.

The operations of a topographical survey are two-fold namely,—to first project a system of points upon such a tangent plane; and, secondly,—to find the distance of the same above or below the plane, or in other words, as the *Engineering Magazine* expresses it "to measure the lengths of the projecting normals." The first process is ordinary surveying, the second, levelling.

Now, in our gold mining districts, the first process has been, or is being (from time to time as occasion demands) performed, and it covers full three fourths of the entire operation and expense. Assuming the lines are run and the stakes are in place, the remainder of the work, that of levelling and marking the reduced levels on the plot of survey, is the easier and cheaper part of the operation.

Provided these operations are carried out with all possible care, the work would be a very exact one. The first and not the least desirable part of the survey, would be to connect each mining district with a common level; the sea level at half tide, for instance. This may appear difficult and expensive, but it would not be so much as it may seem to be at first sight. Many of our gold districts are within easy distance of tidal waters, others are quite contiguous to railways or railway lines of survey where levels reduced from the datum of normal tidal waters can be obtained at any convenient point. Other places more remote should be connected by instrumental surveys.

We may, considering the limited extent of our gold districts in Nova Scotia, reject the sphericity of the globe, and establish a datum level at half tide which can be easily obtained in any of the sheltered harbors that indent our sea coast. For half tide (no matter whether the tides are normal as along the coast, or abnormal, as along the littoral waters of the Bay of Fundy) the half tide level is almost the same tangental level everywhere. If then, we start from half tide, the cost of connecting the most distant district by instrumental survey, would not be more than $50.00 and most of the gold fields to be so connected would not cost half that amount.

Calling half tide level zero, and ascending *gradatum* to a convenient "bench mark" or to two or three of them, as the extent of the district may warrant, their respective elevations should be marked by painting on an exposed outcrop of rock, or on the stump of a tree or other fixed point, "B.M." in feet and decimals of a foot, such as their elevations above half tide may be.

As all sections or profiles of railway location in Nova Scotia, is in like manner connected with levels of tidal water, and changes of gradients noted thereon by "reduced levels" and by what is termed "formation level" of the finished surfacing to receive the ballast bed and also by bench marks placed by the engineers for their use and convenience and as these profiles are on file in the provincial engineer's office or in the case of lines surveyed by the engineers of the Federal Government in the offices at Moncton and at Ottawa, elevations above tide level can be readily obtained at points easily accessible, and easily found at every change of gradient on lines of railway touching or being within easy distance of the gold mining operations. For instance, the profile of the recent location of the Nova Scotia Southern Railway touches the Molega gold district. A mere glance at the profile would give the elevation on any stake (the stakes are placed 100 feet apart) above the tide level at Shelburne. Two or three hours work would extend the levels from present line of railway survey to any desirable point within that district.

Assuming the levels above tidal water to be established and noted on the plan or survey as well as on the bench marks within each district, the next course to adopt would be, to instruct any party sent to extend boundary lines to connect the levels on every boundary, or dividing point, at which he would set or place a stake, and to mark on the stake and on the plan of survey the reduced level of that stake, showing the height in feet and decimals of a foot that their position would be above tidal water. In the interests of all concerned it might be deemed advisable to place levels at every stake within the gold mining district, where lines of survey have been run and where stakes have been already placed, or at least in such districts as the mining operation now being carried on might warrant the expenditure of having it done.

Now, with respect to the expenditure that would be required to carry out the work suggested by this paper to successful completion. Any ordinary engineer, or fairly educated land surveyor should with the assistance of one man to hold the levelling rod, run three miles of levels each working day, and if he would not be capable of performing this service in a reliable manner, he should not be employed. There are men connected with the Mines and Works Office, with the Crown Land Office and with the Provincial Engineer's Office, quite capable of performing such work. If we place the rate of progress (for levelling over lines already cleared, chained and marked by stakes) at two miles per day, and the wages of the surveyor and his assistant at seven dollars per day, the cost per mile for running levels would be three dollars and fifty cents, say four dollars per mile. The extent to be levelled over in each district, can be readily and quickly ascertained by the mining engineer, conversant with the surveys already made, or by inspection from the map of the district, so that, if we take the data given as factors of cost,—and we know from long experience the figures are ample—one can easily estimate the outlay required to develop from the ordinary surveys at present customary in our gold fields, to the more desirable and modern method of topographical surveying. The system proposed, would, as before stated, be a very correct one—the work would check itself.

Firstly, because the boundary lines of property and their sub-division into rectangular areas, must necessarily check at the point of departure.

Secondly, because the levels repeated from stake to stake and closing on the completion of the circuit, must also check, and, because long distances cannot with the same degree of accuracy, be taken by a transit with the so-called stadia wires, and a telemeter or stadia rod. The errors, by this stadia method, may be estimated by feet, whilst by the method proposed by this paper the error could not with any degree of care be computed by so many inches.

Although the new stradia methods of topographical work, such as described by Mr. George J. Specht, C.E., Prof. A. S. Hardy and others in the "Van Nostrand Science Series," have found much favor and is the best known system, where the configuration of the ground over extensive surface areas is required for examination and research. Nevertheless, taking into account what work, from ordinary line surveying, is at present available in our gold fields, and that the method suggested by these remarks would more directly connect and could more conveniently be adapted to local requirements, being less expensive and more expedient than the stadia method, we might be led to infer it would be the more advisable to adopt.

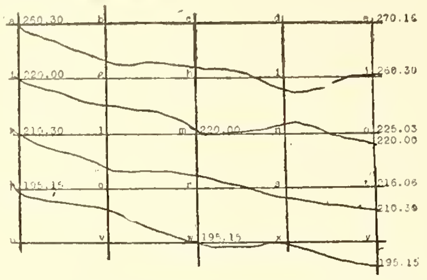
A good example of this form of stadia surveying may be seen in the Mines and Works Office here, by a plan of survey made by Mr. W. B. Dawson, west of Halifax, under the direction of Dr. Gilpin in 1882. The map is only 18 miles by 12, its only fault being that there is not more of it. Since then it has been frequently consulted by the author of this paper, for estimating the area of water-shed, receiving rain fall, for water supply, and in selecting the most suitable lines of railway location. It has recently been a guide to the engineers of the Intercolonial Railway, in finding the most desirable location of the line of railway now being constructed between Halifax and Windsor Junction, and if consulted by the mining engineer it may be found no less useful. One can truly say, its use has already well warranted its cost.

Within and around the city of Halifax, contour lines of level at elevation of 25 feet, have been carefully embodied in a map, by the survey corps of Royal Engineers for defensive purposes, with such precision, that without previous reconnoissance I was able by mere inspection of the topography to make a plan and profile in the office and with the data thus obtained to walk over an ascending line of gradient and railway location from Richmond station to the cotton factory. The instrumental railway survey that followed, showed no preceptible deviation on the ground. These lines of contour are projected in the same manner as suggested by this paper; their connection would, however, be more convenient having stakes, as fixed points, marking the respective elevations in the gold mining districts.

If the lines of survey pass over such hilly or undulating ground, that considerable differences of level are necessarily encountered in its path, valuable aid may be derived from a pocket aneroid barometer. This instrument consists of a flat cylindrical box exhausted of air, the top of which is thin metal corrugated in concentric circles, so as to render it quite elastic. As the atmosphere pressure increases, the elastic top of the box is forced in or down, and as it decreases it is forced out or up. This movement in the top of the box (due to changes in the atmospheric pressure) is conveyed by multiplying levers and a small chain, to an index needle, moving over a circular scale, graduated to correspond with the standard mercurial barometer. The spiral spring by its tension raises the long arm of the lever when the pressure on the top of the box is lessened, thus keeping the short arm of the lever constantly in contact with the fulcrum. The aneroid is used by the following rule: The sum of the reading at two stations, is to their difference, as 55,000 (or twice the height of the atmosphere in feet) is to the elevation required. Thus, if the reading at the foot of a hill is 30.05, and at the top 29.44, we have the following: 59.49 ; 0.61 ; 55,000 feet ; 564 feet. Generally speaking, the fall of one inch in the barometer indicates a rise of about 900 feet in elevation, and the intermediate tenths and sub-divisions of tenths, are in proportion to the rise.

917 feet above sea level the barometer falls 1 inch.
1860 " " " 2 inches.
2830 " " " 3 "

By the intelligent use of this barometer, the scope of enquiry may frequently be much narrowed at the outset, and labor and expense greatly abridged. If, as we have so far considered the blocks of areas are marked by stakes on their respective corner boundaries (according to the present practice) and their elevations above the sea level also indicated thereon and referred to on the plan of survey, so that these data can be readilly ascertained by inspection, contour lines may be run between them by the barometer with a sufficient degree of accuracy for all practical purposes. Suppose, for example, that stakes have been so fixed at the points a, b, c, d, e, etc., etc.



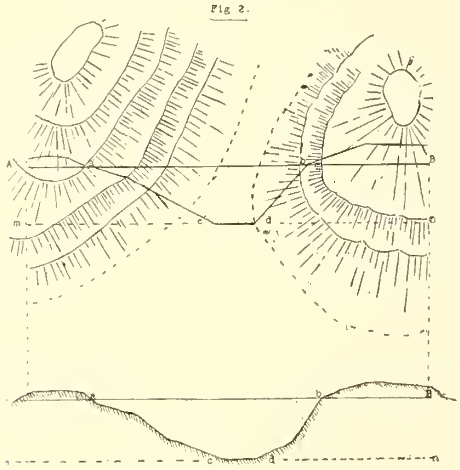
Assuming the strike of the vain, if taken at the plane or level of the dotted line m, n, to have a straight direction, all veins no matter whether vertical or inclined, would have the same bearing.

If the dip is vertical, the inequalities of the surface will not interfere with the course or bearing, no matter on what rugged or undulating surface it is taken.

If the veins or beds dip at any angle of inclination from the surface, the true bearing of the veins can only be correctly taken on the level planes, or if taken on ascending or decending ground, they must be reduced to a level plane to obtain the true bearing.

Fig. 2 shows the deviation from a straight line, a dip of 45° from the vertical would assume along the surface in crossing such a ravine as represented by the profile. 45° being half a right angle, the dip would be onc foot horizontal to one foot vertical.

Fig 2.



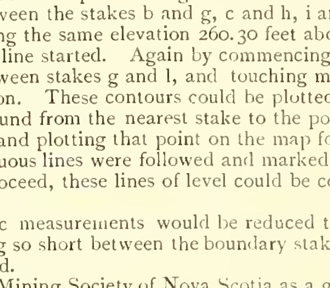
From the stake a, one could carry the barometer in their hand and by moving over the sinuosities of the surface in a path having the same reading, could follow closely a contour line passing between the stakes b and g, c and h, i and n, to j where the line should check on j, it being the same elevation 260.30 feet above the sea level as the stake a, from which the line started. Again by commencing at b, one could follow in like manner passing between stakes g and l, and touching m, where a check could be also affected, and so on. These contours could be plotted on the map by measuring the distance on the ground from the nearest stake to the point at which the line would cross each ordinate and plotting that point on the map for the projection of the line of contour. If these sinuous lines were followed and marked by small stakes as the barometric path would proceed, these lines of level could be conveniently projected along the ground.

The error due to barometric measurements would be reduced to a minimum in these instances, the distance being so short between the boundary stakes where the altitudes would be so correctly noted.

This is not submitted to the Mining Society of Nova Scotia as a geological paper. I may, howerer, Mr. President, be permitted to refer to some principles of rudimentary geology, so far only as may be necessary to illustrate my paper on topography and its use.

The auriferous belt of quartzites and slate bordering the Atlantic shore, present in many places a considerable uniformity of strike, generally, between West and South, N. E. and S. W. is about the average prevailing course. The beds undulate in synclinal and anticlinal folds, often of no great magnitude, as in the neighbourhood of Halifax and its vicinity. In other places such as Goldenville and its neighborhood, there is much more uniform dip. The country is generally low, rugged and broken or boldly undulating. The course of the glacial movement has been tranverse to the line of strike and has furrowed the valleys forming the beds of the principal streams, evidences of which may be observed at the falls of the Port Medway, Liverpool and Jordan rivers. Frequently along the sea coast, and occasionally inland, granite bosses, varying from miles to a few acres in extent, protrude through the slate, so that, in endeavoring to discover the limits of successive beds of sedimentary deposits, other planes are met with, and it is often difficult to decide which is the true plane of stratification and which is the plane of cleavage. All these causes and others, such as faults denudations, etc., tend to create a diversified hilly or rolling surface sometimes bare, and often covered with drift or boulder clay. However, when these disturbing forces are studied by the mining expert in his own special line of research, the mechanical effects must be better understood, and in these respects, surface surveys may be of some service.

Fig 3.



Supposing a mineral vein run across a depression, cropping to the surface on the higher ground, each side, but lost in the low ground being covered with drift.

Let a, b represent the higher ground and c, d the lower, thus :—

Thus in an altitude of 75 feet, the deviation from a straight line, would be 75 feet.

In like manner if any party prospecting or searching for the extension of a quartz lead was in possession of :—

I. A table giving the horizontal unit measurement for each degree and fraction of a degree of dip.

II. A clinometer to take the dip and,—

III. A barometer to take the altitude.

Much assistance might be rendered in finding the local deviation of a dipping lead over rough ground, from a straight surface line.

In a topographical map, the configuration of the ground is reduced to an image, which represents to the eye a large area at one glance. which in nature could not be viewed but by many separate inspections ; therefore, the judgment about the relation of the different parts of the work, will be a clearer and more intelligent one, and this refers more especially to mining work where frequently the problem occurs to strike a vein in a certain level.

Notes on the Behaviour of some Gold Solvents.

MR. F. H. MASON, F.C.S. (Truro) : This paper I wish to say at the outset is, as the title implies, a few notes made on experiments I have been carrying out in my laboratory, and is intended purely as a preliminary to a later paper dealing more fully with the subject. It will serve the purpose of showing you the lines on which I am working and will thus I hope bring about a lively discussion when I read my next paper on the same subject. My experiments are not sufficiently advanced for me to draw many conclusions from them as yet, so I intend mainly to give you just the results of the experiments, drawing only a few hypotheses on them. Secondly, I should like it to be clearly understood that with regard to the experiments I have made on the action of potassium cyanide on gold, I had not the slightest idea at the time that Mr. J. S. MacClaurin, B.Sc., of Auckland University, New Zealand. has been and is also working on the same subject. I received the Journal of the Chemical Society towards the latter part of last month, and I find that in some respects our experiments have been identical.

"Train up a child in the way he should go," is an exceeding good old proverb. I have been taught from my earliest experiences with regard to the treatment of tailings and concentrates with potassic cyanide, to exclude as much air as possible, and that sufficient was safe to get in to complete the solution of the gold ; while an excess of air was likely to reprecipitate the gold in the ore, owing to the carbonic acid gas it contained, and owing also to its power of oxidyzing potassium cyanide to a cyanate. I should probably not have departed from this idea but for an accident. I proposed making some experiments on the precipitation of gold from its solution in potassic cyanide as a double cyanide of gold and potassium. To do this I decided to dissolve some pure gold foil prepared for me by Messrs. Johnston & Mattley, of London, in a solution of potassic cyanide. As luck had it, part of the gold foil was not immersed in the liquid and I noticed after two or three days that on the surface of the liquid action was going on much more rapidly than in the liquid itself, while in another day the gold foil was completely cut off at the surface of the solution and that part which had previously been outside now fell into the liquid. I made a mental note of the fact and left the gold to go on dissolving for over a week. As the gold was still undesolved I decided to see if I could hasten matters by passing a stream of air through the liquid and this brought about the solution of the gold rapidly, at the same time a slight precipitate was formed of a white gelatinous character, looking much like either aluminum hydrate or silica. I may say the air was drawn through the liquid with a filter pump and the air of a laboratory, as you all know, is liable to contamination from many sources, with a view to eliminating this source of error as much as possible in all subsequent experiments, I first passed the air through a strong solution of caustic potash. In 1846, Elsner, I believe, for the first time enunciated the equation representing the reaction which takes place when gold is dissolved in potassic cyanide.

$An_2 + 4\,K\,C\,N + O + H_2\,O = 2\,K\,An\,(C\,N)_2 + 2\,K\,H\,O$, and in the face of that equation which we believe to-day represents the reaction, and the fact that the cyanide process has been running for some years under patents, the validity of which I do not propose to discuss, as I consider comment needless, it does seem strange that up to now everyone appears in working the process to have left the supply of oxygen entirely to chance. My next experiment was a comparative one. I took two pieces of gold foil each weighing ·1 gramme, one piece I placed in a stoppered bottle with an eighth of a litre of a ·2% solution of potassic cyanide. the stopper was removed from time to time and the bottle shaken. The other piece of gold was placed in a flask with a similar amount of cyanide solution and of the same strength, and air was first drawn through a solution of caustic soda and then through the solution into which the gold was placed. I must here state that the arrangements of my laboratory are such that it is not safe to allow water to run on very frosty nights so the filter pump which was asperating the air through the solution had on some occasions to be stopped at night. The gold in the flask was completely dissolved in 72 hours, out of which air was passing through the solution for 45 hours. The gold in the stoppered bottle was now removed, washed, heated to redness and weighed, the weight being ·0770, showing a loss of ·023 grammes or 23%. In the next experiment I took the same quantities of gold and in fact in every way repeated the previous experiment only using a a one-half instead of a two-tenths per cent. solution of potassic cyanide.

The gold became completely dissolved in the flask in 74 hours of which air was passed for 64 hours, while in the same time the piece of gold in the stoppered bottle lost ·0252 grammes. It will be noticed here that the half per cent. solution appeared to be more active than the two-tenths per cent. solution without the air and less active with the air ; this difference I account for by the fact that the gold became more broken up in the early stages of the process in the second case and becoming distributed over the bottom of the flask the air was longer in reaching it. To prove this I started another experiment in which the tube delivering the air was bent round and drawn out to a point, a piece of gold was suspended close to this point by iron wire soaked in boiled oil to prevent corrosion and precipitation of the gold on the iron, thus a stream of air was allowed to pinge against the gold plate, while suspended in a two-tenths per cent. solution of potassic cyanide, the result was that the plate was completely pierced where the air pinged against it, and was grooved where the air went up the sides, thus clearly showing that the presence of air coming actually in contact with the plate of gold while suspended in potassic cyanide solution considerably increased its rate of solution.

The fourth experiment which I intend to bring to your notice was made with a a plate of gold which had been previously coated with mercury. A two-tenths per cent. solution of potassic cyanide was used, and air passed through for twenty-four hours, the plate was then removed, washed and heated at a white heat for several minutes, and weighed ; it lost ·1888% clearly showing that mercury protected gold from the action of potassic cyanide, and this, I assume, may account for the failure of the process in some concentrates, which contain amalgamated gold.

I have also made experiments with concentrates and find that air increases the rate of solution of the gold contained in them, while in contact with cyanide of potassium. Difficulties have been met with which will have to be overcome before I can place any results before you. The air has a tendancy to come up the sides of the vessel containing the concentrates, on account of the reduced friction there, and also when it does find its way through the centre of the concentrates it all comes up in one channel and thus the air never reaches part of concentrates, this of course prevents results from being concordant. These difficulties I hope to overcome before I bring the matter to your notice again.

The experiments have not been as yet sufficiently elaborated to draw any very definite conclusions as to the rates of solution but they clearly show us three things of importance.

1st. That air passing through solutions of potassic cyanide considerably increases the rate of solubility for gold.

2nd. That air coming into direct contact with the gold increases its rate of solubility in potassic cyanide solutions.

3rd. That amalgam on the surfaces of gold protects it to an enormous extent from the solvent action of potassic cyanide.

I am now going to tell you some experiments I have made with another solvent for gold with which you will probably be more familiar, namely, mercury. That gold combines chemically with mercury we all know, the composition of the amalgam appears to vary considerably, Roscoe states that a crystalline amalgam containing two molecules of gold to from 3 to 16 molecules of mercury may be obtained. That such amalgam must be difficult to analyse will be at once obvious owing to the tenacity with which mercury adheres to the amalgam.

I was anxious to see what proportion of gold remained in solution in the mercury and whether the proportion was constant, so I made the following experiment. 97½ grammes of pure mercury and 2½ grammes of pure gold were placed in a bulb tube, a horn was drawn out from the glass tube just above the bulb, and the tube was kept at a temperature of from 90° to 100° C for a week, it was then allowed to cool gradually in the oil bath, and then to stand for 24 hours, at the end of that time the point of the horn was broken off and the mercury was tapped into another bulb tube from which six horns had been drawn out, at approximately equal distances from each other; in this tube the mercury was allowed to stand for 24 hours. By beginning with the top one, and breaking off the points of these horns the mercury was withdrawn a section at a time. These quantities of mercury were dissolved in nitric acid and the gold weighed. I should say that the mercury was drawn off at a temperature of 60° F. They gave the following results.

	Grammes.
No. 1.—Weight of mercury	12·1917
" gold	·0116
Equal to	·0951%
No. 2.—Weight of mercury	7·0710
" gold	·0068
Equal to	·0961%
No. 3.—Weight of mercury	7·5883
" gold	·0073
Equal to	·0961%
No. 4.—Weight of mercury	7·4340
" gold	·0071
Equal to	·0953%
No. 5.—Weight of mercury	7·1165
" gold	·0069
Equal to	·0962%
No. 6.—Weight of mercury	6·2140
" gold	·0059
Equal to	·0965%

From these results it is clear that mercury becomes saturated with about ·096% of gold at a temperature of 60° F.

The amalgam in the bulb tube was next dealt with, this was of a crystalline nature with mercury adhering to it. I took a quantity of this and ran it over clean silver foil to get as much mercury as I could away. I took a weighed quantity of this and placed it in boiling nitric acid; when action ceased the mercuric nitrate was decanted off and the gold placed in a porcelain crucible and heated to a bright red heat for a considerable time, it was then weighed the result being that the amalgam contained 19·964% of gold. The gold thus obtained was of a semi-crystalline nature, and viewed through a microscope is extremely beautiful. From their appearances I should judge that they are not crystals, but the skeletons of a crystalline amalgam from which the mercury has been dissolved. This amalgam appears to nearly agree with the compound $An_2 Hy_4$ which contains 19·78% of gold.

Now, it appears to me that what really happens is, that first of all the mercury chemically combines with the gold and then this compound dissolves in the excess of the mercury.

The question which now arises is: Are the chemical properties which exist in mercury with regard to gold, sufficient to explain its power of collecting gold in our stamp batteries? I think not. I think we must look at its physical properties too. As most of you know on the surface of all liquids there exists a kind of elastic skin, if a drop of liquid be placed on a support it does not "wet" and if there are also placed on the same support, small particles of substances, some of which it will "wet" and some of which it will not wet, it will select those which it has the power of wetting and enclose them within its elastic skin, while it will leave untouched those particles which it has not the power of wetting. If the drop of liquid be now moved it will carry off those substances which it has wetted (provided they are not too heavy to break the skin) and leave behind those which it did not wet. Now this, I think, is what really happens with mercury and assists it to an enormous extent, in its power of collecting gold.

Notes on the Collection of Nova Scotia Minerals being prepared for the Imperial Institute, London, by the Government of Nova Scotia.

Dr. Gilpin—Mr. President—I find that my promise to give your society a paper on the above subject has landed me in a very big contract, if I am to attempt to do justice to the minerals. I shall therefore not attempt to do more than convey to you in a general way the amount of work that has been done and what remains to do.

As you are all aware the Imperial Institute in London is an ambitious scheme. No other country but England however could undertake it, as it is to be devoted to the exhibition of the resources of the Colonial Empire. In this vast building it is proposed to make an economic exhibition of everything that each colony can offer to the investor, the experimenter and the capitalist; to bring together under one roof the products of the Indies, and of the islands of the south as well as those of the colonies lying nearer the north pole. By degrees each colony is accumulating there samples of its flora, new woods, grasses, etc., all its varieties of food fish, its minerals, in brief reproducing itself in everything that assists man in accumulating wealth, or ministers to his comfort. The Canadian Government has been engaged in forwarding the necessary samples to enable this country to make a proper showing. The Government of Nova Scotia, desirious of maintaining as far as possible the identity of the province which would under ordinary systems of exhibition become lost in the representation of the great territorial area of Canada, undertook to make an exhibit in the line in which it was most directly interested. The subjects most directly appertaining to Nova Scotia in connection with the Institute are fish, minerals and lumber. The fish resources of Nova Scotia are, as you know, varied and extremely valuable. No study of the present day is perhaps, equally fascinating, and few researches are more directly profitable to a government and a nation than those directed toward the propagation, protection and marketing of the harvest of the deep. This subject has hitherto received only a fair attention from the Dominion Government, and it is to be hoped that a comparison with the efforts of other countries as viewed at the Imperial Institute, will lead to a more vivid interest in this great source of wealth. Of the lumber industry it may be said that while it is more directly connected with the local government its representation at the Institute will form part of the general Canadian collection. It is expected, however, that before long arrangements will be made for a small but complete exhibit of our woods and their products.

The minerals of Nova Scotia have, owing to their retention by the Crown, proved an important and increasing source of revenue, and are naturally that resource in which the Government is directly interested. This obviously led to the selection of a mineral exhibit as a means of giving the Province of Nova Scotia a distinctive position at the Institute.

I have been engaged for some time past in collecting samples of our ores and minerals for the space allotted to the Province. Naturally the collection sent to Chicago was utilized as far as it went, but I have fortunately been able to supplement it, and to replace some of the material by better specimens. No system has been followed in forwarding the minerals. They have been boxed as collected and sent to the provincial agent. Much yet remains to be done, and as soon as the spring opens further attention will be given to the work. It will be understood that, as this collecting process is in addition to my regular departmental work, I am unable to do it either quickly or as satisfactorily as I could if left free to give it undivided attention for a short time.

I am not going to give you the geological history of each sample or its composition, etc., as that would lead me into a mineralogy of Nova Scotia, and I would be repeating much that is well known to all of you, and many of your members are experts in all that I would refer to, and much better qualified to instruct you than I am.

A prominent place in the exhibit is taken by the iron ores. This may be explained by the considerable interest which has been taken in iron making during the past few years. There are about seventy-five specimens of limonite, bog ore, magnetite, specular, red hematite, and various carbonates representing the principal deposits. This is added to by specimens of the slack washed, and unwashed, and coked, used at Ferrona, and by the fluxes used at this place and at Londonderry. The Pictou Charcoal Iron Company contribute a complete set of specimens in a neat case, showing their ores, fluxes, fuel, and manufactured product Samples of Bessemer, forge and foundry pig are included, as well as a finely finished set of samples of steel shafting, rails, angles, etc., made by the Nova Scotia Steel Company.

It is interesting to note here the fact which I believe to be correct, that Nova Scotia is the first of the English colonies to make commercially steel from native ores. Of course steel was made from charcoal pig a number of years ago at Londonderry, but the process was discontinued some years before the starting of the New Glasgow steel works.

Samples of coal are shown from various mines in Nova Scotia proper, and it is expected that the Cape Breton coals will shortly be represented. A few samples of marble are shown, but the East Bay stone will be included as soon as rock is available away from the surface.

The samples of building stone number 22, and comprise several varieties of granite, sandstone and freestone. These samples are nearly all cubes of from 6 to 12 inches, polished, dressed, etc. Several ochres are shown from Halifax county. The large number of deposits of "mineral paint" in Nova Scotia invite investigation. While a poor paint brings hardly any price permitting of its elaboration, search may show that our carboniferous limestones may yield some of those valuable umbers which bring a good price. In this connection fineness of texture and clearness of color are, I believe, important requisites. Two samples of barytes are shown. I have no sample of the Cape Breton barytes, which occurs at several places.

The collection of samples illustrating the gypsum of Nova Scotia is not yet complete. I have forwarded 11 samples, illustrating the various fibrous, crystallised and other forms. I have yet to get samples of the mineral as it occurs in the Windsor and other quarries, so as to show it from its economic standpoint.

There are 12 samples of manganese, principally from Hants county, although Halifax, Colchester and Cape Breton are represented. The ores as shown by the samples are high grade. It is probable that we have here deposits of this mineral adapted for the steel makers' processes, and their mining would probably prove quite as profitable as that of the higher grades.

Several samples of ordinary brick clays are shown, and the Acadia Coal Company contributes samples of fireclay, raw, ground, and made into firebrick.

There are also samples of the Rawdon antimony, of lead ore and other less important minerals. Mr. Mason has kindly given me samples of copper ores, notably of the sulphides and carbonates from Waugh's river, Colchester County. The ores of Ohio and Polsons lake and of Coxheath are represented. I have also sent, more as a curiosity than as an indication of economic value, seven samples of native copper from the North Mountain trap, the largest weighing about five pounds. I regret to say I was unable to lay my hands on some large and very interesting native copper samples, holding notable amounts of silver from the College lake, Antigonishe County, I had some years ago.

I have also secured about 30 specimens of the agates and other trap minerals, some of which are polished. Several boxes with views of Nova Scotia scenery have been forwarded.

There remains yet the gold exhibit; for this I have the small but rich samples now in the possession of the department, and hope to purchase a few more, so as to have a small but rich set of gold samples that can be shown under a glass case. The gypsum exhibit requires to be completed, and there are a number of miscellaneous minerals, such as pyrites, fluor spar, molybdenite, etc., which I hope to gather up as opportunity offers.

I would feel under great obligations for any assistance that could be given in this matter by the society as a body, or by its members; as well as for any advice that may help the work. I have already stated that I am not advancing as rapidly as I would wish, but have to make the most of my opportunities.

A Novelty in Mine Ventilation.

MR. ALEXANDER DICK—It is almost impossible to say anything on the theory of the ventilation of coal mines which could consistently be called a novelty, as writers by the dozen have so thrashed out the subject since the days of Atkinson that one is almost inclined to endorse the old saying that there is "nothing new under the sun."

The particular point which I wish to make at present has, however, nothing to do with *theory*, but is a description of a new departure in the practical ventilation of a coal mine, which I hope may be of interest to all mining men who have fans at work at their colliery.

We Nova Scotians know that in winter considerable trouble is caused by the hoisting shaft—which is commonly the downcast—becoming sludged up with ice. And all over the world this ice difficulty has been one of the greatest inducements to mining men to prefer a blowing to an exhaust fan.

There are many arguments pro and con which have from time to time been presented in the technical press, and before learned societies, as to which type of fan was preferable, and I do not intend to trouble you with a recital of them. It is sufficient for the purpose of my paper to say that I think the choice of fan—either blowing or exhaust—depends greatly on the climatic conditions of the mine. If an exhaust fan is adopted, the hoisting shaft is used for a downcast, and the fresh air on entering the mine travels first along the main haulage roads where naked lights are used, if anywhere, and the fouled air passes through some return airway where travel is *nil*, and danger of explosion is minimized. If, however, the mine is situated in a locality where frosts are frequent and severe, the cold, frost-laden air in going down the hoisting shaft often impedes work and commonly stops operations altogether. The remedy for this has been hitherto to reverse the air, and instead of sucking it down the hoisting shaft to blow it down the fan shaft and up the hoisting shaft. By so doing the warm air in going up the hoisting shaft has kept it free of ice, and thus advantaged the working of the colliery.

This reversal of air has, however its disadvantages, as follows:

(1) The fouled or impure air is turned into the main haulage roads, where all the traffic of the mine is concentrated, and where naked lights are almost invariably used.

(2) All the doors which were used to obstruct the air when travelling in one direction are utterly inoperative when the air current is reversed, and either duplicate doors have to be supplied or those in use have to be re-hung so as to shut in the opposite direction.

(3) The free gasses which in fiery mines are constantly being exuded from the coal face are kept back by the pressure of the ventilative current, and, far fetched as the argument may seem, it is nevertheless perfectly understandable that at the moment of reversal there will be a cessation of pressure which will permit large bodies of free gas to obtrude into the airways and general workings, and when the current again begins this gas will be carried through the workings and afford excellent opportunities for an explosion.

Suppose then we have a colliery where we are troubled with ice in the winter, but we are in favor of exhaust ventilation. Is there no way by which we could combine the merits of the two systems? I say there is, and I will now present to you a method by which the air can be allowed to travel through the workings in a given direction by an exhausting fan, yet if it be suddenly changed to a blowing fan, the air while it is reversed in the shafts and their immediate vicinity, will not be altered in direction in the general workings. By this means the hoisting shaft will be kept warm in winter, and the three objections which I have just cited will be overcome, namely:

(1) The main haulage roads will be almost entirely in the fresh air as before the change.

(2) The same doors will do for either an exhaust or a blowing fan.

(3) There will be no cessation of ventilative pressure.

For the purpose of explaining this method I have prepared a plan of a mine consisting of four sections worked by two shafts. The hoisting shaft "H" is sunk on the main level, while the fan shaft "F" is situated to the rise of the shaft's pillar.

The coal is worked simultaneously from four districts, one of which is situated on the main level on each side of the hoisting shaft, while the other two are similarly situated on an upper level which is approached by parallel headings driven from the hoisting shaft. Each of these four districts is ventilated by a separate split of the air current.

I may say that in presenting this plan I am not presenting any particular system of mining. For my present purpose such is entirely unnecessary, and I only ask you to look at the plan from a ventilation point of view.

Suppose that the fan at "F" is acting as an exhausting fan, the air will go down the shaft "H" and will take the following course. I will only describe the course of the current in sections 1 and 3, as section 2 is ventilated in the same way as 1, and 4 as 3. Let us take section 1 first.

The air leaving the bottom of the shaft "H" travels to the left along the main level. You will observe two roads in the first pillar in the form of a St. Andrews cross. One of these roads crosses the other at the point *a* by an air-bridge. In each of these roads, both of which communicate directly with the fan shaft "F," are doors *b b* opening towards the hoisting shaft. These doors prevent the air from getting to the fan shaft directly without first circulating through the entire district. You will also observe that there are two doors *c c* on the main haulage road which open readily *with* the current. There are also doors *d d d d* at the foot of each gate road leading to the working stalls. The air, therefore, coming down the hoisting shaft "H" travels along the main haulage road and following the course indicated by the arrows, arrives at the point *e* close to the fan shaft "F," and crossing the haulage heading by the air-bridge at *f*, reaches the fan shaft up which it is exhausted.

We will now consider section 3.

The air when it leaves the hoisting shaft "H" is split at *g*, and the portion of the current in which we are now interested travels up the heading to *h*, part of it going straightforward to ventilate the headings to the rise, while the balance turns to the left along the level road in section 3. From this point it follows the course of the arrows until it reaches the centre heading at *i*, where it joints other splits on its way to the fan shaft "F."

These are the courses which the air takes in the case of a fan acting as an exhaust.

We will now suppose that the fan has been suddenly reversed, and is now acting as a blowing fan, remembering, that while this is so, we do not wish to change the direction of the current in the general workings. As the fan is blowing the air down the shaft "F" we will start from the bottom of that opening and follow the current until it reaches the hoisting shaft "H." Here it is that the St. Andrews cross roads come into play.

Take section 1 again. The air leaving the fan shaft crosses the air bridge at *f*, and its course to the workings is stopped by the door at *e*. It is obliged, therefore, to turn down the only available opening *k*, by which it reaches the main haulage level at *l*. Its passage to the hoisting shaft "H" is impeded by the two doors *c c*, and the only course left for it is to take the old journey around the workings as shown by the arrows, until it reaches *e*, there it turns to our left to *m*, and thence by the over bridge to the hoisting shaft and thence to daylight.

Now let us take section 3. The air leaving the fan shaft "F" passes by the overbridge *a* to the main haulage heading. It is prevented from making its way to the hoisting shaft by reason of the doors *c c*, and therefore travels as before, around the workings as indicated by the arrows, until it reaches the point *n*. From there it goes by the under bridge at *a*, and the other under bridge at *f*, to the hoisting shaft.

Having described the arrangements underground, let me now show you how the change is effected at the fan. And here let me say that the whole thing is done without requiring the fan to be even stopped for one instant.

I present here a plan and sectional elevation of the fan arrangements. The fan is of the ordinary Guibal type. You will observe that the fan is placed clo-e to the shaft, and that the circular casing is projected by means of an epicycloidal curve to embrace the top of the shaft on the one side, and the évaseé chimney on the other. There are two shutters marked "A" and "B." These shutters run in channel-ways similar to a roll-top desk. The shutter "A" is raised to open a passage by means of a similar balance weight, and it retreats, on being lowered, into a close compartment in the side of the shaft, as shown in the drawing. This type of fan receives its air at the side as at "D" on the plan, and discharges it at the tips of the blades.

Suppose the fan is intended to act as an exhaust fan. The shutter "A" is opened and "B" is closed. The doors "E" and "E" are closed, as shown on the plan. The air coming up the shaft comes around the side of the fan to "D," and is then exhausted up the evaseé chimney.

If it is decided to change the fan to a blowing fan, the following operations are all that are necessary. First see that reliable men are placed at each set of St. Andrews cross roads to open and shut the necessary doors at a given hour. At the same hour open the shutter "B" at the fan and close "A." Throw open the doors "E" and "E." The latter will then close up the opening to the shaft, and the fresh air going in at the opening "D" will be blown down the shaft into the workings.

DISCUSSION.

MR. R. H. BROWN—We have at the Sydney mine such a fan as Mr. Dick describes. We have the Guibal fan, 30 feet in diameter and ten feet in width, and we have also the Murphy fan. It has a revolving head and you can alter the ventilation in the mine in five minutes. We have not operated it because we use the exhaust.

MR. A. DICK—At the Uniontown, Pa., mine there is quite a distance between the two shafts, and they found it an advantage because one set of cross roads did for the five splits of the mine. The Murphy fan is favorable to this reversing idea. There is nothing original in it. It is a home made system of shutters.

MR. HAYWARD—Why is it necessary to change the air from upcast to downcast?

MR. DICK—Ice forms in the downcast shaft in winter time.

MR. HAYWARD—Would you advocate it in a mine worked for years?

MR. DICK—I would not reverse the air through the workings. This saves you from doing that. It would not be advisable to do it where there is a large distance between the shafts.

DR. GILPIN—If you had shafts a mile apart you would have to have two miles of airway.

MR. DICK—I don't want a discussion as to whether it is necessary to reverse the air, because I personally would prefer exhaust. It is only on account of difficulty from ice that I would change the air. If you require to make the hoist shaft an upcast in the winter time you have to reverse the air and in this way you don't reverse the air in the general workings. I certainly would object to changing the air if it could be avoided, but it cannot be avoided in some places. In Pennsylvania they have the reverse fans.

MR. BLAKEMORE—It is absolutely necessary to reverse the air in our shallow pits in Cape Breton. There is a great difficulty in maintaining a temperature a little over freezing point. We used the Bond system but it did not succeed. This winter we applied this frame system not exactly in the way sketched there. In the Caledonia mine, an old one, we made a cross over one hundred feet from the shaft on either side and reversed the air only between the shafts. It was successful. I should say with Mr. Dick that there is the greatest possible objection to reversing the air current throughout the mines but there is no danger in reversing it for 100 feet or so near the shaft. It would not be advisable, however, to do it in deep shafts. I call to mind a case six or seven years ago where we decided to reverse the air current and make the downcast an upcast. We had everything outside the mine, men, horses, etc. The shaft was twelve hundred feet deep It took us an hour before we could get the air reversed in the two shafts and roads connecting them. I don't think any man would care to take that risk. You cannot afford to suspend the ventilation for an hour. The reversing of air should be confined to shallow mines. There is no danger if you reverse the current just in the immediate vicinity of the shaft.

MR. DICK—You had a Waddle fan at Caledonia?

MR. BLAKEMORE—We had no fan in before that. The fan we are using in the Caledonia is a Murphy fan twelve feet in diameter.

MR. DICK—I am glad to hear that Mr. Blakemore has had some experience in this matter. I did not know that such a thing was in operation in Cape Breton. I only heard of one case in Uniontown, Penn. I should like to repeat that it is not a question for one moment as to the advisibility of reversing the air either in the shafts or in the workings, but it is a question of fans operated on this principle. They change the direction of the air all through the workings and when the change is made they have to have duplicate doors opening in opposite directions. In this case you do not require duplicate doors, you may have to change the air and it is a question which is the best way to do it. If you reverse the air right through the mine and bring your foul air along the main haulage ways it is a great mistake. Under this system you don't have to do that.

MR. BAIRD—I think your plan is a saving and could be carried out in certain places.

MR. DICK—In old mines where there is a considerable distance between the shafts it would be a difficult matter to adopt it. Where it is put in there are only some hundreds of yards. The idea is simply to save the expense of duplicate doors, and do away with the reversing of the air current in the working places.

MR. BROWN—If the shaft is making ice, why not heat the air going down? Would that be objectionable?

MR. DICK—I suppose there would be no serious objection. Heating might retard ventilation.

DR. GILPIN—They had steam pipes at the Foord pit, Albion mines, and the air passed through them.

MR. DICK—Raising the temperature would not have an appreciable effect on the ventilation. In Pennsylvania they have a fad for reversing the air.

MR. FERGIE—The mines are shallow, are they not?

MR. DICK—Yes, at an easier inclination.

MR. FERGIE—I think that ought to be taken into consideration and also as to whether they are gassy mines or not. I whould not like to reverse the air in some of the Pictou mines. —*To be continued.*

An Evening with the Ferro-Manganese Auriferous-Carbon Variety Troupe.

By the Junior Reporter.

Subsequent reflection in company with a large over-dose of sombre thought has made me arrive at the conclusion that the "subsequent proceedings" of the banquet of the Mining Society in the Halifax Hotel on the 13th March were such in their iniquity as to necessitate their being laid before the public in their awful bareness. There!

The Melancholy Middle-aged Man from Joggins with the roan outcroppings on his chin, showing where he had been shaved last, who sat next to me at the convivial board turned a deprecating eye upon me.

"Is your name coupled with any of the toasts?" he gurgled, as he put pepper on his pie; and then, after a mouthful, put his plate gently away with a *penseroso* sigh.

"Oh! *that's* what's the matter, is it?" I said cheerily, as I fished my napkin up from the floor with my fork and helped myself to a little *consommé* of intermittent hash with a fine gravy background, for I had come in late and was several laps behind the Melancholy Man. "So you're down for a *speech*, eh?"

"I am to make a few remarks upon SUDDEN DEATH ON THE UNEXPECTED ACCUMULATION OF WEALTH THROUGH GOLD MINING," answered the Melancholy Man in tones that had not left off their mourning yet. And he drew out by main force a MSS from his breast pocket about the heft of the *Federal Budget*; and I noticed that his chest measurement shrank visibly.

"Thank God! you won't have a chance!" I murmured with fervent and irrelevant thoughtlessness. "There's a new order of things in vogue to-night. See!"

As I spoke the company rose and filed out of the banquet hall, each one being handed a card bearing the terse and ominous insciption:

> ADMIT BEARER
>
> TO
>
> CHAMBER OF HORRORS!!
>
> —
>
> D.T.—Gold Cure Graduates enter at their own risk.

Then I knew that I had been absorbing too much champagne in quartz, and prepared to do business at the old stand.

We were escorted to a spacious apartment, at the farther end of which was a sort of stage, with all the accessory paraphernalia of curtain, entrances, footlights, etc. Some men were fiddling a sort of Tannhauser-like dirge in the orchestra row, and I heard a dog far off howl at the moon.

Everyone seemed possessed of the desire to leave the place; but there was a weird, uncanny fascination about it, and we stayed.

The curtain was the first to rise; quickly followed by several bald politicians with depraved countenances, who pressed down to the front and fought one another for the first seats.

I turned my eyes away, while chaste blushes chased each other round the circumference of my collar. I saw that the Melancholy Man had seated himself upon his few remarks, in order to get a *higher* view, and was gazing with wrapped attention towards the stage awaiting the opening number of the

FIRST AND ONLY APPEARANCE

OF THE GRAND

FERRO-MANGANESE AURIFEROUS CARBON VARIETY TROUPE

In a Glittering Coruscation of Specialties.

IN TWO ACTS.

The siren meantime sang with considerable *sang fraw*, abandon, and several other things, some verses; one or two of which, to show the depravity of the gentlemen who were responsible for their perpetration, I am constrained to reproduce:

"A living picture here you see,
As artless as high art can be;
A lady, too, of high degree,
The Countess of *Clamcarty*!
A model of the Paris school,
I set my net to catch a fool,
In some ancestral hall to rule
An eligible party!"

"My *lines* I'm sure you will agree
Are classical exceedingly.
Just listen to my song, and see
If Sappho's 'hims' could beat 'em!
My curves are most 'correct' in swell;
I'm aphrodite on the shell!
I'll leave it to the boys, and—well,
If *they* say no, I'll treat 'em."

Then a bold-faced person sheltering himself under the assumed name of *Boak*, with a voice that would have done eternal credit to the contrabasso rumblings of a suppressed earthquake, came brazenly forward. This was the *tenor* of *his* debased unmusical muse:

"Oh, drearful are the luckless moans
Of him who plays in chipless luck;
Bewailing loud in laughless tones
The cards that potless ran amuck!
And dourly doth he greet the morn
That followeth such *change-less* chance,
The while he finds with brow forlorn
No silver lining to his pants."

Mr. A. S. S. Wylde filed a plaintive ditty entitled "The dynamiter's lame end," the plaint whereof in halting stanzas recorded that:

"I blew a hole in a safe,
Which was an unsafe venture,
But I wanted to unsafe that safe,
And make my own indent 'yer!
My pal said: 'Ere's a mine!'
But his tongue struck a vein of bunkum,
For the owner his ducats that day
Into a mine had sunk 'em."

"I blew a hole in the ground,
I thought sure I'd struck suthin',
For there they said *brass* had been found,
But blow *me*, I struck nothin'.
So I struck an old gent for his tin,
And blew myself while it lasted,
And now I'm blastin' rock
In a quarry, worse luck, blast it!"

Another "living picture," and I placed one hand over my flushed brow, and with the other endeavored to hastily pull down my undiscovered locks to cover my intense emotion and some of my face. A creature from Torbrook grossly misrepresenting a fair and innocent heroine of fairy fiction, came brassily forward and struck a pose. It also struck the bald parties on the left and right—*i.e.* in the front row—for they applauded the female's action and called her "Birdie." This creature who had the carriage of an American heiress—without the groom—held by a string a small affair, which upon close and careful inspection—through the crevices between my fingers—I discovered to represent the titled and tottering heir to the throne of some Teutonic state. The living picture next raised one bare foot, displaying upon the sole thereof the word "Trilby" and the numerals "99." This was grossly opposed to biblical tradition, for the scriptures expressly state that the lost *sole* was the other *one*. Then the wretched type of degenerated aristocracy knelt and placed a small glass slipper upon the largest toe of said foot. The latter, with the assistance of its mate, ambled down to the *foot*lights, in order that we might more critically examine this terrible product of current fiction, and their owner trill(by)ed:

I'm Trilby, as you all can see;
For short I'm Cinderella,
My escort here is named Billee,
I got 'im in Vienna.
They call him William over there,
And Emperor of Germany.
He's kind of shrunk and got quite spare
Since he came to Amerikee.

Perhaps I'll tie to him some day,
And Empress, then, dad says I'd be.
This one is quite a nob, they say,
But I love my land—and liberty.
I'll pose as that come presently,
In bronze, like them that Byrnes is runnin',
I was a model in Paree,
And so of course I do it stunnin'.

(NOTE:—The Nabob of the "Golden Lode" was at this stage expected to give an acrobatic performance, but owing to the depth of the shaft, he was unable to crawl out of his hole in time.)

The next item embraced "A few remarks from Brother Gardiner"—a gentleman, by the way, whose appearance was suggestive of a recent excursion to a coal pit or an encounter with the opaque night—for the dog had by now "howled down the moon." He wore a northerly and semi-circular demarcation line, painted white, about his neck, a pale pink bertha with lager beer trimmings, and some underclothing that had been left to air on the dog kennel, as the wearer hitched himself regularly every five seconds during his delivery.

"Gem'lem," said this worthy, "we stan' hyar tonight to discuss federation!—No, no!—to dessicate upon the hypersqualateral insignification ob de glorious umpossibility ob Repairs to de Rock Drill, as proposed to the antithetical diagnosis ob de analysis ob gold solvents! Feller fellers and odder fellers, you has all seen de disgustin' and highly elevatin' disquisition ob de enraptured females who has stood befo' you heah dis ebenin' in all the glory ob deir pristine pristiveness, for de eddyfication ob your intellectual and odder degradation. In de languige ob de Remejial Order on de price ob school books an slate pencils in Alaska in de case ob a fall in de manufacture ob seal, or on de odder hand in de sweet words ob Decameron's Horn,—whar are we at? We stan' heah, you miserbel ole bal' heads, an' ebery mudder's son ob us, and all de time de price ob coal is risin', Gould is being dixcovered by de French in Noo Yawk, de niggers is smokin' de bes' Havana cigaroots at de expense ob de Government, de Mickadoo he am habin' his shirts cum home widout any laundry bill, an' dese bootiful shemales has pandered to your immoral prejudices, an' is now fixin' demselves up wid bronze paint out ob an ole tin can for de next turn. In de words ob de poet Spokeshave I will close my perambulatin' discursion:

"Lives dere a man wid soul so dead,
What nebber to hisself has said:
I'll get drunk 'fore I go to bed,
An' get up in de morn wid an achin' head?"

Upon the retirement of this ebon effigy, which was hastened by a sudden shower of vegetable diet not down in the 'probabilities,' a female in evening dress came forward. Her countenance was utterly depraved, and her clothes were cut shocking low; which was accounted for however when she announced in a brazen voice that she was a vision of judgment by the name of Mrs. Own-the-town Chant. During her vocal rendering she cast amorous glances at the older and more hardened men, and seemed to take an unwholesome pleasure in staring at the younger and modest portion of her audience, including myself. A verse or two of her vicious jingle will show the depths of vileness to which this woman by strict attention to other people's business had descended:—

You've heard me chanted far and wide,
My fame it is quite settled ;
Of County Council I'm the pride,
Tho' several I've nettled.
But *those* are only folk, you ken,
Who hate hypocrisy ;
Whose pride is they are Englishmen,
With British liberty.

To purge the *Empire* of all crime,
The girls ! Oh ! how I chased 'em !
Nor stayed until in joy sublime
Upon the street I placed 'em !
I bribed the old men at the board
With amorous sly advances ;
And to suborn a dean or lord,
I gave 'em all their chan(t)ces !

The master of ceremonies announced that the Black Nugget of Dartmouth would scrap four rounds to a finish with the White Diamond of Mosquodoboit. These celebrities came forward, the time-keepers, sponge-holders, referee and backers took their places, including "the man from Boston," and at the magic word 'time' the Nugget and the Diamond joined forces, so to speak—something anomalous in mineralogical history,—and the battle was on.

Round 1. The Black Nugget led carefully with his left foot, and succeeded very carefully in planting some corn in the most arable portion of the Diamond's cerebellyum. Elated with this success, the Nugget made a wild pass, a sort of an Afghan curve, at his opponent, and laid open the Diamond's nose, making it a cut diamond. The latter, however, still somewhat in the rough, by hastily swallowing something from a black bottle handed him by the man from Boston, contrived to walk on the Nugget's feet and claw the Nugget's wool. During this onslaught the Nugget gave a magnificent exposition of his want of science by biting large helps out of the most tasty portion of the Diamond.

Round 2. This round was rather tame, as during it only one eye was totally destroyed and one ear completely obliterated. It was nevertheless enlivened by a fistic altercation between a corpulent anti-Federationist named Willis and a piratical looking individual named Sword, who carried a banjo. The banjo was somewhat mutilated before these two opposed and enthusiastic supporters of the principals were prevailed upon to retire to the buffet.

Round 3. In this round the audience was somewhat augmented by the presence of several clerical gentlemen and the mayor and chief of police—the last named disguised as a man—of a neighboring town. This party entered the hall by main force, and complained bitterly at not having been the recipients of proper invitation cards. In this round the Nugget contrived artfully to get behind the Diamond and butt him in the kidneys with his bullet-like and bullet-proof head ; while the Diamond managed to retort with his spiked heels upon the shins of his plucky assailant. Honors and the pieces were about evenly divided when the gong rang.

Round 4, and last. The Diamond did not wait for his opponent to leave his corner, and proceeded thither at the instignation of the man from Boston and hit the Nugget upon the chin in an uncalled for manner with a piece of ore from the Coxheath copper mines. Thereupon the supporters of the Nugget claimed a foul and proceeded to "polish" of the Diamond and make him ready for the market, so to speak. The man from Boston with his old time agility sprang to the Diamond's aid ; and in the *melee* which immediately followed all of those directly interested in the combat and a great many non-official onlookers took part. When quiet had been restored, and the "stiffs" had been, to use Colonel's John Hay's beautiful language, "piled outside the door," it was discovered that two disipated looking persons hight Hardone and Scarr had taken their places before the failing footlights for the avowed purpose of warbling "Louisburg," a concerto in P flat.

"Ye gentlemen of England,
That live at home at ease,
Ah ! little do you think upon
The dangers of the seas."

Whereupon a great number who had no ear for music left the building abruptly among them the faithful chronicler of these events.

Seriously, the programme of entertainment provided for the members of the Society by Messrs. C. E. Willis and Geoff. Morrow was of a decidedly unique and highly amusing character, and must have entailed an immense amount of labor to these gentlemen in its preparation. The tableaux were one and all original, well made up, excellently staged, and carried through in a manner that showed careful rehearsal. A word of praise is also due to Messrs A. S. Wylde, George Boak, the brothers Leckie, G. W. Sword, and J. P. Lithgow, for the very fine programme of vocal and instrumental selections rendered during the evening. Mr. R. P. Greenwood made an efficient stage manager, and Mr. Willis was in great form as master of ceremonies, particularly during the amusing boxing tourney between the niggers of Dartmouth. The programme was a work of art and will be cherished by one and all present as a souvenir of one of the most diverting of the many thoroughly enjoyable re-unions for which the Mining Society is famous. Mr. George E. Drummond, Vice-President of the General Mining Association of Quebec, thoughtfully purveyed a case of his celebrated "Radnor" water, which was much appreciated at the refreshment buffet. Mr. John M. Reid, of the Oxford Gold Mines, at present in California recuperating, also forwarded a case of very fine vintage from that country, but unfortunately it arrived just too late for the majority to drink a glass to his speedy recovery and return to the province.

Remarkable Reef Discovery.—Advices from Kimberley state that while the Rand Mines, Ltd., was busy constructing a large dam on its property immediately to the south of the Goldfields Deep, on the farm Elandfontein, the ground was scratched a little to the east of the dam, and at a depth of 2½ ft. a reef was struck showing visible gold, though at the surface there was no outcrop to indicate the presence of reef matter. The reef turns out to be of rich banket, and pans up to 4 ozs. or 5 ozs. Operations being continued, the reef was easily traced, and at a depth of 17 ft. a body of 5 ft. ore was encountered, also carrying visible gold. The find has naturally caused considerable commotion amongst claim holders in the neighborhood, and the point where struck is within 2 ft. or 3 ft. of the boundary. The ground into which it dips belongs to a Mr. Hartman. The demand for claims has in several instances resulted in business, and it is reported that Mr. Wagner has since purchased thirty claims for the sum of £4,500. The question is to what series the reef belongs. It has been decided that it is not of the Kimberley series, or of the Black Reef series, and it has yet to be proved that it is not merely a "blow," although experts say that to all appearance the samples brought into Johannesburg suggest a permanent and payable banket proposition.

FAN VENTILATION.

Plates Illustrating Paper read by Mr. A. Dick, before the Members of the Mining Society of Nova Scotia.

Fig. I.

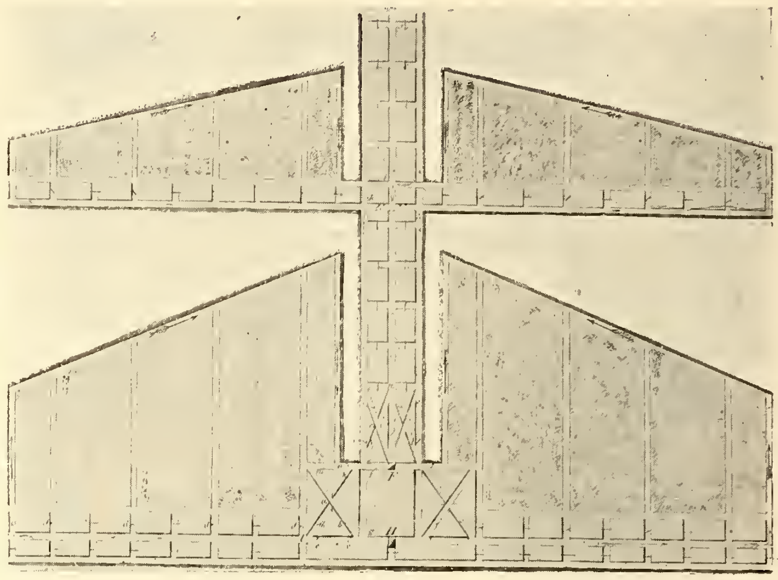


Fig. II.

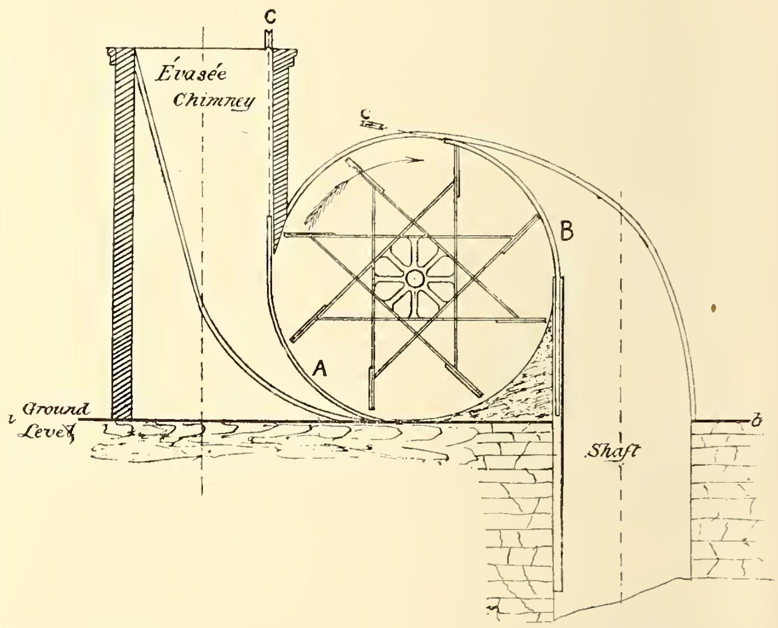
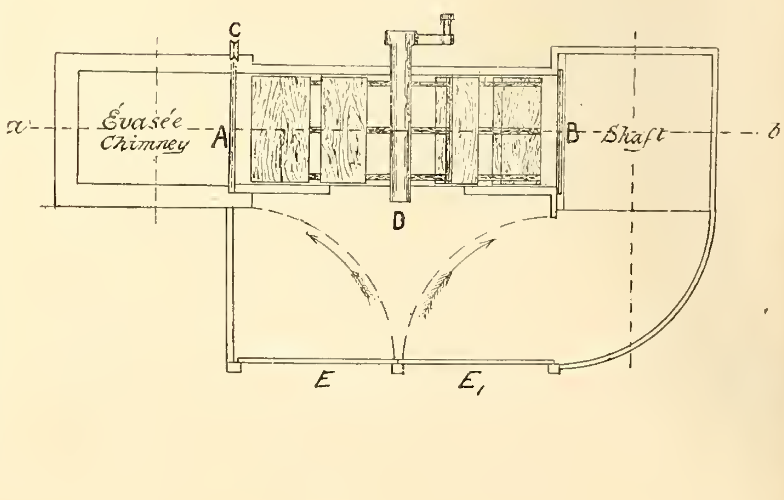


Fig. III.



CORRESPONDENCE.

The Geological Survey and Its Mining Statistics.

To the Editor :

Sir,—On page 6 of your issue for January of this year a statement is made which calls for notice and correction.

Mr. John J. Penhale in his paper on the Asbestos Industry in 1894, read before the Quebec Mining Association, criticizes the figures of production of this mineral issued by the Geological Survey, apparently finding a discrepancy of some 12,531 tons in our figures from 1882 to 1892 as compared with the shipments of the mineral from points on the Quebec Central Railway during the same period. This matter was explained by myself fully at the meeting, but as the discussion was not reported I beg leave to repeat here the statement then made, as follows :—

First—Mr. Penhale takes shipments over the Quebec Central only, whereas he should have obtained also the Grand Trunk shipments from Danville, where one of the largest operators is located, also the small amount shipped from Templeton on the Canadian Pacific Railway.

Second—The table in our report to which he refers distinctly shows that for the years 1880 to 1886, previous to the issuance of mining statistics by the Survey, only Customs figures of exports are available. By reference to the explanatory notes on the first page of the report it will be seen that we claim no great accuracy for figures not obtained by ourselves, which are simply given for lack of any others and for what they are worth. In the nature of things export figures, being collected as a rule by men unacquainted with the technicalities of mining, are apt to be in error. Of this we have frequent evidence whilst checking them as far as we can from our own knowledge of Canada's mineral industries.

Third—We have for years used railroad shipment returns as a guide in checking our totals. After many conversations with railroad men, we have found that these also are admittedly only approximate, and in almost every case not likely to be so accurate as direct returns.

Fourth—The suggestion made at the meeting that we should get railway returns to correct our other figures is therefore superfluous.

In conclusion I would assure our critics that every possible means is taken to check our figures in many different ways. I will not take up your space in detailing these here, but could they know the amount of time necessarily consumed in doing this for all the organized and unorganized mineral industries of the whole Dominion, they would, I think, understand some of the causes for delay in issuance of the reports and conclude that, taken all in all, the figures given are as accurate as it is possible to have them.

With apologies for taking so much of your space,

I am, Sir, yours, &c.,

ELFRIC DREW INGALL.

Geological Survey of Canada,
Division of Mineral Statistics and Mines,
February 18th, 1895.

LEGAL.

Chatham National Bank vs. Lewis McKeen and The Eastern Trust Company, Liquidator of the Mabou Coal and Gypsum Company, Ltd.

In this appeal to the Supreme Court of Canada the questions involved arose in the winding up of the Mabou Coal and Gypsum Company, Limited, under Chapter 129 of the Revised Statutes of Canada and the Winding-up Amendment Act of 1889. An order was duly made by the Supreme Court of Nova Scotia under the provisions of the Acts to wind up this company, and appointing the Eastern Trust Company liquidators. This court subsequently ordered the liquidators to sell *en bloc* at public auction, at Mabou Harbor, C.B., all the real and personal, portable and moveable property and effects of the company, excepting the steamer "Eldon," and on 20th June, 1894, the property was sold to the respondent, Lewis McKeen, for $1,100. It is claimed that McKeen, being a director of the company, and therefore in a fiduciary position towards the company whose property he bought, was disqualified from becoming the purchaser and they appeal to nullify the sale.

COMPANIES.

Mabou Coal and Gypsum Co., Ltd., (in Liquidation.)—The total amount of money realized from the property and assets of this company is $2,510.53 (including $1200 received from the sale of the steamer Eldon.) The total amount of claims filed with the liquidator by creditors amounts to $59,949.71, and of these the preferred claims figure $12,524.01. The Chatham National Bank of New York is a creditor to the extent of $4,938.51, with interest at 6% from 5th February, 1894. At a sale of the property last summer the leases and rights to quarry and ship plaster and gypsum, together with a steam grinding mill, wharves, scows and other property, and the rights to work certain coal areas were knocked down to Lewis McKeen, Sec.-Treas. of the Company, for $1,100. An appeal is now before the Supreme Court of Canada to annul the sale on the grounds (1) that the price was grossly inadequate. (2) The order for sale fixed no upset price. (3) The advertisement was insufficient. (4) That the purchaser (McKeen) was a person who, if not in such a fiduciary position as would render the sale void, was in a position which, under the the decisions, gave him an advantage over other bidders, and which gave him an opportunity to conceal his information respecting the value of the property which he had gained as a trustee, and which it was his duty to disclose to others.

Lillooet, Fraser River and Cariboo Gold Fields, Ltd.—Letters of allotment had been posted, as per advices by last English mails.

Bell's Asbestos Company, Ltd.—The directors propose a dividend for the year ended 31st December, 1894, of 10% per annum together with a bonus of two per cent., placing £5,000 to the reserve fund and carrying £3,592 15s 5d forward. The dividend for 1893 was 5 per cent., and for 1892 7½ per cent. The result of the year's operations was a net profit of £21,261.10 ; to which has to be added amount brought forward £1,731.5.6, from which after deducting £5,000 for reserve there remained for appropriation as above, £17,992.15.6

Danville Asbestos and Slate Co., Ltd.—This company is being incorporated under Dominion Charter with an authorized capital of $250,000 in shares of $100. Directors : F. Boas and M. Boas, St. Hyacinthe, Que.; J. N. Greenshields, Q.C., Montreal ; Wm. Sclater, Montreal ; B. Sheppard, Montreal ; and W. T. Costigan, St. James St., Montreal, Managing Director. The company, which at present operates under certain conditions the well known Jeffrey asbestos mine at Danville and owns and operates a slate quarry and other property in the same neighborhood, is preparing to engage still more extensively in these enterprises.

Intercolonial Coal Co., Ltd.—The annual meeting of the shareholders was held at the office of the company at Montreal on 6th instant, when the old board and officers were re-elected.

Dominion Coal Co., Ltd.—Mr. F. S. Pearson, engineer of this company, will shortly take residence at the Canadian headquarters of the company at Glace Bay, C.B., for the season. Messrs. Kingman, Brown & Co., agents of the company at Montreal, have completed arrangements for the St. Lawrence shipping trade. While several of the boats are no strangers to the port of Montreal there will be several new boats added to the fleet, including the steamships Mucia and Huelva, which are now on the shipbuilder's stocks. These boats will make their maiden trips to this port soon after the opening of navigation. The other boats chartered are the steamships Coban, Bonavista, Cacouna, Louisburg, Cape Breton, Abbeymoor, Ipsden, Sunshine, Daylight, Sunrise, Turret Bay, Turret Age and Turret Bell. Messrs. William Doxford & Sons (ltd.) of Pallion yard, Sunderland, Eng., are building for Messrs. Peterson, Tate & Co., two new turret boats to run on the St. Lawrence route this season. The two latter boats are specially designed to enable them to go through the canal with a cargo of 3,000 tons.

Black Creek Hydraulic Mining Co. of Cariboo, Ltd.—Has been incorporated in B.C., to take over and acquire mining leases of lands or mining claims in any part of the province, and in particular nine tracts of 160 acres each, on Black Creek, Cariboo District, for which tracts of lands application has been made for mining leases, and a mining lease granted 15th February, 1893, of a tract of land on said Black Creek to the Black Creek Hydraulic Mining Company, and to acquire all the rights and interests of all parties interested in any mining claims on Black Creek and Club Creek, and the water privileges in connection therewith. Authorized capital, $300,000, in shares of $5.00. Head office : Vancouver. The trustees are : W. F. Salsbury, Johann Wullfshon and Edward Mahon.

War Eagle Gold Mining Co., Ltd.—Registered at Victoria, B.C., under the Foreign Companies Act, 18th February. Authorized capital, $500,000. Head office : Spokane, Wash.

Northup Gold Mining Co., Ltd.—Has been incorporated by an Act passed during the present session of the Nova Scotia Legislature. The principals are Clarence H. Dimock, Windsor ; Joshua H. Smith, and E. Norman Dimock, Windsor. Authorized capital, $100,000, in shares of $100. Head office : Windsor, N.S.

Consolidated Gold Mining Co., Ltd.—Incorporated by an Act of the Legislature of Nova Scotia, 1895. Authorized capital, $400,000, in shares of $1.00. The principals are Henry C. Walker, Dartmouth ; James Reeves, Halifax ; G. W. Crease, Halifax ; W. A. Temple, Waverley Mines, and J. B. Neily, Halifax.

New Glasgow Coal Mining Co., Ltd.—Incorporated by an Act of the Legislature of Nova Scotia, 1895. The opening clauses of the bill specify that whereas John McIntosh and Robert Drummond, of Stellarton ; Angus Chisholm, Harvey Graham, John Fraser, Thomas Fraser, James F. McLean, A. C. Bell, Evan Kennedy and Jeffrey McColl, all of New Glasgow ; John W. Sutherland, of Thorburn, and Wm. J. Stairs, of Halifax, have been conducting the business of gold mining under the name of the New Glasgow Gold Mining Company, Ltd., at Goldenville, in the County of Guysborough, and the property now owned by them, consisting of mining areas, buildings, machinery and plant, has cost the company upwards of $12,000, they are desirous of obtaining an act of incorporation. The said Angus Chisholm, John McIntosh, and Jas. A. Fraser, their associates and successors, are created a body corporate by the name of the New Glasgow Gold Mining Company, Ltd., with head office at New Glasgow. Authorized capital, $20,000.

Nova Scotia Coal and Gypsum Co.—By an Act of the Legislature of Nova Scotia the Inverness Mining and Transportation Co. has acquired power to change its designation to Nova Scotia Coal and Gypsum Co.

Nova Scotia Steel Co., Ltd.—The directors of this company (an amalgamation of the New Glasgow Iron, Coal and Railway Co. and the Nova Scotia Steel and Forge Co., Ltd.) are Graham Fraser, New Glasgow, President ; Frank Ross, Quebec ; John F. Stairs, M.P., Halifax, Vice-President ; Adam Burns, John McNab, J. W. Allison, J. D. McGregor, J. M. Carmichael, and E. F. McKay, directors. Mr. Thos. Cantley, New Glasgow, has been appointed secretary of the amalgamation. A bill confirming the sale and transfer of the properties to the new company was passed at the last meeting of the Nova Scotia Legislature.

The Cape Breton Coal, Iron and Railway Co., Ltd.—Incorporated by an Act of the Legislature of Nova Scotia, 1895. The principals are Henry Mitchell, Old Bridgeport, C.B., John A McKenzie, Donald Matheson, John D. McVicar and Walter Crowe, all of Sydney, C.B. Authorized capital, $250,000 in $10 shares.

The North Sydney Mining and Transportation Co., Ltd.—Incorporated by an Act of the Legislature of Nova Scotia, 1895. Principals, William Maury, St. Louis, Missouri, John Greener of North Sydney, and Mytton Maury of Cambridge, Mass. Authorized capital, $200,000, in shares of $100.

Montreal Quarry Co., Ltd.—A prospectus of a company under this designation has been issued. It is proposed to acquire for $152,000 certain quarry properties in St. Denis Ward, Montreal, and to carry on the business of quarrying and selling stone. The properties consist of 2,170,000 feet superficial, more or less, upon which quarrying operations are now being carried on, and from which has been taken much of the beautiful grey limestone used in the construction of the finest buildings in

Montreal. The quarries are fully opened up and have a working face of 2,000 ft. and are well equipped with plant. The authorized capital is placed at $200,000 in shares of $100. The provisional board comprises Ald. Peter Lyall, P. A. Peterson, C.E., D. G. McCaskill, W. G. Reid, George McDougall.

Bras D'Or Marble Co., Ltd.—The officers of this company for the ensuing year are Rod. Macdonald, Halifax, *President* and Messrs. G. E. Franklyn, R. Uniacke H. Saunders, S. Mosher and G. Hattie, all of Halifax.

Barachois Gold Mining Co.—The directors of this Nova Scotia company are: Steven Davidson, Rod. Macdonald, B. M. Davidson, and W. A. Adams. The mine is at Wine Harbor, N. S., and 40 persons are at present employed.

British Columbia Goldfields Exploration and Concessions Company, Ltd.—Registered in Victoria, B.C., 13th March, 1895. Authorized capital, $500,000, in shares of $5.00. Directors: J. M. Browning, Harry Abbott, A. G. Ferguson, Charles Wilson, and J. M. Buxton, all of Vancouver, B.C. The objects for which the company is to be formed are—

(*a.*) To acquire, by subscription, purchase, exchange, or otherwise, any approved shares in companies operating or about to operate any mining claims in the Province; also to acquire, by purchase, lease, exchange or otherwise, any gold or other mining claims, whether developed or not, in the Province of British Columbia:

(*b.*) To acquire, by purchase, lease, or otherwise, any water rights, lands, or property, either real or personal, that it may be found necessary to acquire for the proper working, operating, and developing of any gold or other mining claims in the Province that the company may acquire or have an interest in:

(*c.*) To make sales of, or dispose of in exchange or otherwise, any shares in mining companies operating or about to operate, or of gold or other mining claims, water rights or property, either real or personal, connected therewith, in the Province of British Columbia to any person, persons, body or bodies corporate:

(*d.*) To promote and form companies having for their object the purchase and development of any gold or other mining claims in the Province of British Columbia, and to subscribe for shares in the same:

(*e.*) To employ prospectors to ascertain the value, position and locality of any claims, and to acquire the same, when duly ascertained, by purchase, lease, or otherwise.

Trail Mining Co., Ltd.—Has been registered under the Foreign Companies Act, B.C., with a capital of $250,000, in shares of $100. Head office, Chicago. The objects for which the company is established are:—To engage in, operate and manage the business of mining, milling, smelting, and refining ores, metals, and minerals; to buy, sell, and deal in ores, metals, and minerals of all kinds, and to acquire so much real and personal property as may be necessary to carry out the above objects—said objects and business to be carried out, conducted and performed in the State of Illinois, in the Province of British Columbia, Canada, and elsewhere.

Lake Lode Gold Mine.—One of the most notable advances in gold mining operations, and one distinctly creditable to the owner and to the province, is the completion of the fine milling and mining plant installed at the Lake Lode Gold Mine, Caribou, Halifax County, Nova Scotia, owned by W. A. Sanders. The mill building is commodious and strongly built on solid concrete foundations. The power is furnished by a 50 h.p. Robb Armstrong engine and 80 h.p. Economic boiler, built by the Robb Engineering Co., of Amherst. The stamps weigh 875 lbs. drop 100 to the m., and the cams, shoes and dies are of the finest chrome steel, specially imported for the purpose. The mill has been built by Messrs. Matheson & Co., the well known engineers of New Glasgow. The other equipment includes a Hendy Challenge feeder, a Blake ore-breaker (built by the Jenckes Machine Co.), a 30 light dynamo, and an Eclipse steam pump for fire purposes. The mill bins have a capacity of 200 tons. A new hoisting engine (Bacon double drum, link motion, 10 x 15 cylinder, 4 ft. drum) has also been supplied by the Jenckes Machine Co. The pumps have been supplied by the Truro Foundry and Machine Co. The gallows frame is 75 ft. high and connected with the mill building by a 300 ft. trestle. Below ground a new feature in Nova Scotia gold mining is the ore bins, having a capacity of 200 tons. It is a notable fact that this property, from which Mr. Sanders is securing a remunerative investment on a yield of something like $5.00 to the ton, was abandoned by the former owners as worthless and was ultimately disposed of at sheriff's sale for a song. A force of 30 men are at present employed.

Le Roi Mining and Smelting Co.—At the annnual meeting held at Spokane, Wash., this month, the old board was re-elected as follows:—G. W. Forster, G. Turner, W. D. Turner, D. W. Henley, W. M. Redpath, L. F. Williams, J. W. Binkley, I. N. Peyton and W. J. Harris. The Le Roi is opened to a greater depth than any other mine in Kootenay. The working shaft is 360 feet deep. The 50-foot level extends 30 feet west, and is being extended to connect with an air-shaft that is being sunk 50 feet west of the working shaft. The 200-foot level extends east 100 feet and west 75 feet. A raise of 50 feet is made from the west drift. The 250-foot level extends west 50 feet, from which a raise runs to the 200-foot level. The 300-foot level extends west 100 feet and east 70 feet. From the west drift is a 25-foot raise. The 350 level extends 20 feet west and 20 feet east. The bottom of the shaft is in ore the full width.

Bell's Asbestos Company, Ltd.—The seventh ordinary meeting of shareholders held in London on 7th instant. Mr. Henry Heywood, who presided, said: I have now, gentlemen, to propose the adoption of the report and balance sheet, and as "good wine needs no bush," very little labor is required on my part to-day to commend so satisfactory a report to your approval. It is, I am sure, a great pleasure for us to meet you here under very different circumstances from those which have prevailed since you did me the honor of electing me on the board. We have had falling dividends for the last three years; but I think we have reached the bottom, and are now on the first rung of the ladder which, I hope, will lead to greater prosperity. The accounts are so clearly put before you that it is scarcely necessary for me to make comparisons, and I doubt not you have already compared this year's balance-sheet with the previous one. The accounts have been audited with the usual severity by Messrs. Cooper Bros. & Co., and you may therefore rely on the strict accuracy of the figures in every respect. The first item, I think, which will have attracted your notice will be the very satisfactory one of £28,443 by profit at London and branches and asbestos estates, Canada. The explanation of this is very simple, and for the purpose of such explanation I might divide it into three parts—Firstly, that of the increased sales which have been effected both in this country and the colonies. We have certainly done a very greatly enlarged business, and are endeavoring to extend the advantages we have already secured in the colonies and elsewhere. In whatever places we see an opportunity of doing a profitable business, in such a place you may expect to find an agent of Bell's Asbestos Company, Limited. I have also been pleased to learn, and I am glad to tell you, that many of our old customers, who left us some years ago for reasons I need not enter upon, are returning to us. (Applause.) Whether it is due to the very careful selections at the mines, by hand-picking of the fibre, in the first instance, or to the greater care in every process of manipulation in Southwark Street, in my opinion, and certain it is, the manufactures of Bell's Asbestos Company are the best of their kind made in this country or anywhere else. Further, gentlemen, we find that those of our customers who were sparing in their orders have now larger accounts with us, and I attribute this fact—and it is confirmed by experience—to the superior quality of our manufactured article, to which I have just alluded. The second point I wish to refer to as having enabled us to show higher profits than hitherto is on the question of the stock. It is common knowledge to you, I think, that some years ago, when prices were very high, it was thought to be to the advantage of the company to make very extensive purchases of manufactured asbestos. As prices have fallen from that high figure, we have, in taking stock, religiously written down the value to the lowest point of the time, and in doing so have necessarily been obliged to take away a very large sum—some thousands of pounds—from the profits of each year. I want this to be quite clear. Naturally, when you write down the value of a large stock to the extent of some thousands of pounds, you take away a considerable sum from the profits you have earned. At the end of 1893 we appeared to have got to rock bottom, and it has not been necessary during 1894, I am very pleased to say, although the stock has been valued with the greatest severity, to write down any portion of our profits on account of that asbestos loss. That stock has now been considerably reduced, and this, in itself, is, I think, very satisfactory. Then, again, the severe times have taught us a strict lesson with regard to economy. With regard to the mines, what I said last year will apply to-day. The reports we receive from them are perfectly satisfactory; I cannot say they look any better or any worse. The managing director made his usual visit during the early part of last year, and he was accompanied by Mr. Lightfoot. He reported to us on his return all that we expected he would say; that is to say, he simply confirmed what I have previously told you. He is good enough to tell me that if any shareholders cares to ask any questions with reference to the mines, he, personally, will be very glad to answer them. You will notice an item here that has not appeared before—£750 for machinery reserve fund. We have written down the machinery to its correct value, and we have spent a considerable amount out of revenue in putting it into first rate order. There is not a machine on your works that is not thoroughly and efficaciously employed. Still, the conservative policy which has guided us somewhat from the first suggested that we should provide a fund in case of any new discovery being made or new machinery invented which we might find it profitable to employ either here or at the mines, and, therefore, instead of probably withdrawing a large sum either from revenue account or from the larger reserve fund, we thought it advisable to set aside, as a beginning, £750 for the purpose of providing new machinery, should it ever be required. Naturally it will be. At the same time we write off also each year and take a valuation of the machinery, just as we value the stock, with strict and great severity. Now, gentlemen, one word with regard to the suggestion that the dividend should be 10s. per share, together with a bonus. Upon this point your board had a very long discussion. I, personally, may be too conservative in my views. As you know, I have maintained all along that our first duty here is to put the works in a very strong position—(applause)—and I take it from you, by the applause, that you approve of that course, inasmuch as you wish us to write off the goodwill, and you would also, I daresay, like something written off the mines. So should I. But it was argued, on the other hand, that many who are shareholders to-day will not be to-morrow, or at the end of the year; and that the proprietors at the present time who have been with us during the course of the year are entitled to such reasonable profits as we have made, after setting aside a reasonable sum to reserve fund. I think probably what had more weight with me was this—that we have done very well, while the prospects are equally buoyant, and that as we have had to pay smaller dividends in the past two or three years than we hoped to, we might on this occasion pay 2 per cent. by way of bonus. Therefore it is that we have come to the decision to recommend to you the payment of 10s. a share and 2 per cent. bonus. With these remarks I beg to move: "That the report of the board of directors and of the auditors, and the financial statement submitted to this meeting for the year ended December 31st, 1894, be, and the same are hereby, approved, adopted, and confirmed." (Applause.)

Mr. T. B. Lightfoot seconded the motion, which was duly carried, and the dividend and bonus were declared. The retiring directors and auditors were reappointed, and the proceedings closed with the usual vote of thanks to the chairman and directors.

Londonderry Iron Co., Ltd.—The following were elected to the board at the last meeting of shareholders: Lord Mount-Stephen; Sir Charles Tennant, Bart.; Messrs. A. S. McClelland, James J. Greenshields, A. T. Paterson, John Turnbull, L. MacD. Paterson. At a subsequent meeting of the board, Mr. A. T. Paterson was re-elected president and managing director, and Mr. John Turnbull vice-president.

Alterations in a Pumping Plant.

Discussion on Mr. McMurtrie's paper before South Wales Institute of Engineers.

Mr. G. E. J. McMURTRIE said that with regard to Professor Elliott's remarks at p. 434, vol. xviii., as to its being better to estimate the efficiency of the engine by the consumption of feed water and coal, in place of taking out the units of heat in the steam from the indicator diagrams, he would observe that on account of the whole of the colliery boilers being coupled up, it was difficult to do so. An attempt was, however, made on two occasions to get at the consumption of coal on an idle day, but the quantity of water being pumped at the time was very small, and although one boiler only was used, and the consumption of fuel carefully weighed, yet the smaller quantity pumped consumed the more coal, due doubtless to want of judgment on the stoker's part. Consequently the experiments were not reliable. The results obtained, however, were as follows:

Feb. 8th, 1893, Coal used 5 tons 19 cwt. in 24 hours, 122,400 gals. pumped.
April 27th, 1893, " 6 " 15 " " " 108,000 " "

It had been found more convenient, therefore to base the efficiency on the heat units obtained from the indicator diagrams.

In reply to Mr. Vaughan's remarks, on pp. 434 and 435, he wished to say that an engine placed at the pit bottom and pumping to land, would have prevented any interference with coal winding, and might possibly have enabled the pump work to be completed earlier. It would, however, have been a very difficult matter to carry the water pipes up the shaft, and the steam pipes down it, without greatly interfering with the work in the shaft, as the new pump work, compact though it was, entirely filled all available space left in the shaft by the cage. In addition, the introduction of steam pipes into a downcast shaft would have interfered with the ventilation.

The actual labor cost of winding the water during the operations was £92 10s., or roughly £100, and the cost of any pump placed underground to pump a possible 300 to 400 gallons per minute to land—which quantity might, at any time, have had to be dealt with, had it been a wet winter—together with the cost of water and steam pipes, and the labor cost of fixing them, would have greatly exceeded that amonnt. It was quite possible, too, that the time taken up in fixing the pipes, &c., would have exceeded the time taken up in water winding, and that there would have been no saving in time. It would probably have taken two single 30 inch engines, with 5 ft. stroke and 10 inch plungers, one placed in the pit bottom and the other half-way up the pit, with steam at 50 lbs. pressure, and each delivering to a height of 450 feet, through 8 or 9 inch pipes, to raise some 20,000 gallons per hour, at a speed of 20 strokes per minute.

The water holes were not driven in order to deal with the water during the alterations, although utilised for that purpose. It had been long felt and proved that the holes were quite inadequate in case of accident to the pumps, and consequently additional water holdage was driven. No part of that cost of that work could, therefore, be charged to the alteration of the pumps.

In regard to the efficiency of the new engine, compared with the old, there could be no doubt that the old one was very badly balanced, but what economy would have been effected by simply improving the balance it was now impossible to say.

In regard to diagram No. 2, plate 25, Mr. Vaughan was probably correct in his supposition that the large reduction in pressure, when the equlibrium valve was opened, was due to excessive bottom clearance, there being a considerable depth in the cylinders below where the piston travelled, due to its formerly being open at the bottom. That, however, was immaterial, as the steam had already done its work before the equilibrium valve was opened. The slight error in the exhaust line in the diagram above the piston, was probably due to the atmospheric line not being in proper position, owing to leakage of steam in the cock at the time the line was taken, or to too much pressure being placed on the pencil at the one time, and too little at the other. Apparently Mr. Vaughan based his estimate of the steam used, per horse-power per hour, on the pump horse-power, which for six strokes = 80, and 6·98 lbs. of steam per stroke × 6 × 60 = 2513, and $\frac{2513}{80}$ = 31·4 lbs. But would it not be fairer to take the indicated horse-power, which would probably be 100 horse-power, giving $\frac{2513}{100}$, or 25·13 lbs. per indicated horse-power per hour. A good result from a single cylinder jet condensing pumping engine, at 50 lbs. pressure, and under ordinary conditions, was 2½ lbs. of good steam coal per indicated horse-power per hour. If the coal evaporated 9 lbs. of water per lb. of coal, it would give 22½ lbs. of water or steam per indicated horse-power per hour. A compound engine working at 100 lbs. steam, carefully jacketed throughout, at a high rate of expansion, might give 16, though 17 to 18 lbs. were more probable. He would ask whether Mr. Vaughan could name a Cornish condensing pumping engine, with a low rate of expansion, and with 50 lbs. boiler pressure, giving 16 lbs. of steam per indicated horse-power per hour? Or was Mr. Vaughan not comparing a Cornish condensing engine at 50 lbs. pressure, and a late cut-off, with a compound condensing Davey differential engine at 100 or 120 lbs. pressure, and a comparatively early cut-off?

THE PRESIDENT said he had read Mr. McMurtrie's paper with a great deal of attention, and the whole question, as it seemed to him, which it raised was, whether it was quite wise to alter the pumps at this colliery at all, or whether it would not have been cheaper, both in the outlay of capital and also in the working expenses, to have substituted a direct acting engine at the bottom of the shaft. The writer admitted in his paper that there was no danger of the pit being drowned; and it always seemed to him that the danger of a pit being drowned was the only justification for a Cornish pumping engine at all. Some figures would show this rather strikingly. Take the maximum duty which the writer suggested, namely, 400 gallons per minute, to be raised a height of 247 yards. The drawings showed the great paraphernalia there was in the pit to pump that quantity of water; yet that maximum duty could have easily been attained with a 9 in. three-throw pump, with 2 ft. stroke, which was a couparatively small affair. The three-throw pump, allowing a very large margin of loss of efficiency, could be driven on the spot. That was to say, assuming steam was taken down the pit, it could be driven easily with 50 lbs. steam, 20 in. cylinder, and 400 ft. piston speed. But to show how disproportionate the pumping plant which had been adopted seemed to be to the work done, let more modern conditions be considered, and with 150 lbs. steam, a high pressure compound engine of 14 in. diameter high-pressure cylinder, and the same piston speed, would be amply sufficient for raising the whole of that water.

To go a step further. Supposing that steam pipes could not be taken down the pit, as, of course it might be a great objection in a downcast pit, and the pumps were to be driven electrically, placing an electrical plant with high-pressure compound engines at the surface, the capital expenditure, even then, would not have exceeded, or at any rate by very little, the cost of making the alterations to the pumps which had been carried out at Foxes Bridge Colliery.

It seemed to him that the great advantages of a direct acting pump would have been specially shown in that particular case, as it would have got rid of all the rods working in the pit, and of all the subsequent repairs to the rods; and there would have been only the rising main in the pit, and either the steam pipe going down, or an electric cable.

With regard to Mr. McMurtrie's remarks as to the consumption of steam, he thought the expectation of working such an engine on 16 lbs. of steam must be a mistake, as no engine, of that class, could be expected to work with such a consumption of steam or anything like it, but with the high pressure and working as he, the president, had suggested, the consumption of steam would very likely be kept down to, say, 18 lbs. per I. H. P.; and, in his opinion, that would have made a cheaper job, and a more efficient one than the mode described in the paper.

MR. T. H. BAILEY said that Cornish pumps were difficult to keep in order, especially in shafts. When they were in order, however, no doubt they worked economically as regarded the consumption of fuel and water. He had just had experience of the way in which Cornish pumps could be kept going. The large one at the South Duffryn Colliery had an 85 in. cylinder, and worked three 22 in. rams, 9 ft. stroke, lifting a height of 210 yards: and they had only changed one clack since February 1893. The engines had been fitted with Davey's differential gear, which was most useful in regulating the working of the engines and pumps; and if those who had Cornish engines wished to get rid of a great deal of the vibration, and the difficulty of keeping their rods in order in the shaft, they could not do better than put the differential gear on to the engines. He quite agreed with the President with regard to electrical pumping, and also, where it was possible, the use of direct-acting pumps at the pit bottom. His experience indicated that the pumping of the future, for simplicity and economy, would be electrically worked.

MR. J. BARROW said the economy of electrical pumping must depend very considerably upon the quantity of water which had to be lifted. He might mention that quite recently there had been a set of pumps put in upon the hydraulic principle, which had had the effect of reducing the consumption of coal a little below one-half what it was with the old arrangement of pumping. In the old arrangements, there had been an old Cornish beam engine, also three special pumps of Haywood & Tylor, and two ordinary plunger pumps; and the steam was taken down a total distance of 900 yards from the boilers. In lieu of those pumps, three sets of hydraulic pumps had been put in, and they had had the effect, as he had said, of reducing the consumption of coal at the boilers to a little below one-half what it was a few months ago. The arrangement of three sets of pipes (one rising main and two tower pipes) down the returns for a distance of something like 300 yards to the first pump, 550 yards to the next, and 800 yards to the bottom pump, appeared to be a little complicated, but the three sets of pumps were working very satisfactorily, the power being conveyed from a compound high-pressure condensing engine placed at the surface, working with a steam pressure of 100 lbs. in the high-pressure cylinder, and in the low-pressure at about 50 lbs. In his view it was a most efficient mode of pumping from great depths, having regard to the quantity of water to be dealt with. As to expense in labor, no fewer than sixteen men and boys had been removed by the application of the three sets of hydraulic pumps. Of course it was a very large scheme, as the water had to be raised some 530 yards perpendicular. Some day, he would have pleasure in preparing a paper upon the installation and working of those pumps.

MR. W. BLAKEMORE would like to say a word or two in reference to pumping by electricity, and in favor of that mode. He had two pumps at work, but prior to the application of electricity, had employed steam, which had proved the greatest nuisance he ever met with in all his experience of pumping underground. The places were so hot that the men could scarcely work; and in consequence of the constant leakages and stoppages he decided to substitute electricity. The arrangement had been at work for some eighteen months, and there had not been an hour's stoppage for anything whatever. He quite agreed with Mr. Bailey that electricity would be the motive power of the future. Having a surplusage of power, he had taken off current for a number of lamps along the main roads, and for the pit bank and engine house; and whilst they only obtained from steam something like an effective power of 40 per cent., they were utilizing from 65 to 70 per cent. with electricity.

MR. GEORGE BEITH said the efficiency of an electrical pumping plant, which he had recently put down, was about 65 per cent. The engines were of the latest high pressure type. The highest lift they had been throwing was 1,000 feet. Previously they were constantly stopped by the steam, but since the change they had been able to get at the bottom of the drifts, and were now driving ahead.

MR. D. J. ARTHUR REES said it was hardly fair to compare electricity with the previous method in the instance just quoted, because there were matters which interfered with making a fair comparison. At present, the electrical pumps had hardly had a fair test, because it had not a quarter enough work. The plant was started in the first week of August last, and was working remarkably well. It had thrown about 6,000 gallons an hour, up a drift, pitching from 20 inches up to 47 inches per yard, for one thousand feet vertical, with a six inch plunger, and the effect so far was highly satisfactory.

MR. T. H. RICHES said Mr. Bailey had referred to the application of electricity to pumping but he did not tell them what was the ultimate efficiency as compared with a pound of coal at one end and water delivered at the other. He was sure it would be interesting to know what that was. Then Mr. Barrow had informed them that he had substituted hydraulic pumps for a previous arrangement of steam pumps; that he put the water under pressure at the surface and transmitted it through pipes to reach his pumps at the face, or wherever he had to pump from. That naturally brought them back to the ordinary use of high-pressure water. Then it would be interesting to know what was the efficiency which was obtained from the pumps as compared with the power put into the water at the surface. He (Mr. Riches) had had something to do with hydraulic mains, and every man who had to deal with them would know that the friction in the pipes was a very serious item. He generally found it most efficient to establish an accumulator in close proximity to the point where the power was taken off. It occurred to him at the moment, that if the work to be done by the pumps was absolutely constant, but little advantage could arise from the existence of the accumulator. In that case the flow of water must be constant through the mains, and whether it was at all influenced by the accumulator, or not, seemed to him of very little importance. But if the work was at all intermittent, it certainly would appear desirable to accumulate the power close to the work. Probably Mr Barrow would kindly give them some information as to what experiments he had tried, and the efficiency which he derived from the hydraulic supply at the pumps, as compared with the power he put into the water on the surface. He also hoped that Mr. Bailey would give them that information as to the efficiency of the electrical pumps. Electricity was, of course, coming into great prominence, not only for pumping, but as a motive power for all manner of driving machinery, hoists, cranes, and so forth. He had been taking little interest in the subject lately, and it seemed to him that there was a very considerable loss which had yet to be accounted for. He noticed there was a large number of overhead traveling cranes in some of the large works in the country, and he had been rather surprised to find the enormous amount of power which was wasted in transmission from the original motor, that was to say, from the steam engines, to the ultimate motor. Information on this point was wanted equally with regard to pumping and non-traversing machinery; and he hoped the gentlemen who had given them some outlined remarks on that occasion would favor them with more details, to enable them to compare the efficiency of the various pumps alluded to.

MR. T. H. BAILEY said in order to get reliable results, they require separate boiler power, whereas the difficulty in that respect was that in colliery electrical plant the steam was supplied from the usual range of boilers.

THE PRESIDENT said they were all very much indebted to Mr. McMurtrie for his Paper, which had led to an interesting discussion, It was true the discussion had rather wandered from the original subject matter of the Paper; and as a question with regard to efficiency had been raised, he was afraid that members might be tempted to engage in experiments which would not compare with one another, unless they all worked on the same basis. In collieries it was impossible to get at the coal consumption, for a pump or anything else, for all the engines were as a rule supplied from the same range of boilers, while pipes very often leaked, and sometimes there was a very long lead of pipe and considerable condensation. He thought the simplest way was for every one to start with the indicated horse-power of the prime motor on the surface. It did not so much matter whether the engine was a good one or a bad one. They wanted to know the loss of power between the engine at the surface and the motor, where the power was used underground, whether for pumping, hauling, or any other work. It was immaterial for that purpose whether the prime motor was a compound engine of a highly economic type, or an engine which had been picked up at the colliery and been utilized for the purpose; they only wanted to know the I.H.P. put into the work on the surface, so as to be able to arrive at the useful result of the electrical appliances underground. They could then make the necessary deductions for themselves as to what the improvement would be if they had a high-class engine on the surface. For the present purpose, it seemed that that was the right direction to take.

MR. G. E. J. McMURTRIE, in replying to the President's remarks, pointed out that the depth of the pit was 300 yards, and that it would consequently require a larger engine than he had described. As had been stated in the Paper, what largely led to the Cornish system being retained, was the fact that there was already a very good engine at the pit if certain improvements were made to it. In addition, the owners preferred the Cornish system of pumping, and consequently thought it best to consult the well-known Cornish firm of Messrs. Harvey, of Hayle, whose advice they absolutely followed.

As he admitted in his opening remarks, at the commencement of the meeting, it was doubtful whether the Cornish engine could compare in economy with a compound or triple expansion condensing engine of the best type, on account of their greater expansion and earlier cut-off. If a direct-acting compound or triple expansion engine had been put down to pump direct to land, at a boiler pressure of 100 lbs., it would have been necessary to provide a couple of boilers, at least, additional, whilst a good Cornish engine would have been practically thrown away. In his opinion, the cost of such an arrangement would have exceeded that of the pump work put down. The expense of putting rods and plungers, &c.. into the shaft is always great, and the progress very slow, which greatly adds to the cost of any engine placed at land. Some reference had been made to the life of the clacks; the four they had in were put in with the rods, and, so far, had lasted one year and nine months. It was believed they were made of elephants' hide.

A cordial vote of thanks was accorded Mr. McMurtrie for his Paper and the discussion closed.

Dominion Coal Company.

Sydney and Louisburg Railway, Total Length of Line from Bridgeport to Louisburg, 27 Miles.

The work done at the close of 1893 consisted in grading and masonry over the first five miles from Bridgeport towards Louisburg, of which three miles were opened for traffic. From the 5th to the 14th mile work had been broken into but only a small percentage of the grading had been done and scarcely any masonry. During the year ending 1894, the whole of the line to Louisburg, with the exception of the sloping of the large cutting near Catalone lake, has been completed; track has been laid to Louisburg: 17 miles of the line has been fully ballasted, and portions of the remaining 10 done. All masonry and superstructure have been completed and fencing throughout two-thirds of the length of the line completed.

The important structures on the railway built during the year are as follows:

Big Glace Bay Brook, steel trestle 150 ft. in length and 25 ft. high.

Black Brook trestle, 150 ft. in length and 25 ft. high.

Mira River bridge, three spans of 100 ft., of which one is a swing span.

Catalone lake outlet, a span of 54 ft.

Catalone trestle, 360 ft. in length, average height of 50 ft.

In addition to the above work on the main line, a branch line 2½ miles in length has been completed, joining the Reserve mines with the main line near Bridgeport. A branch line one mile in length, connecting the Roost mine with the main line near Glace Bay colliery, and also yard accommodation at the Roost mine has been completed during the year. Yard accommodation at Dominion No. 1 mine, sufficient to hold 7,000 tons of coal in cars has been graded, and tracks partly laid. The main line from Bridgeport to International Pier, a distance of 13 miles has been re-laid with 80 lb. rails in place of the 56 lbs., and this portion of the line has also been fenced. The yard approach to International Pier has been completed, and is sufficiently large to hold 5,000 tons of coal in cars. A branch line has been extended to the Gowrie mines, a distances of 1½ miles, and that portion of the line from Bridgeport to Gowrie mines has been opened for traffic, and has passed the inspection of the officials of the Local and Federal Governments. Extensive yard accomodation has also been completed at Glace Bay, where the central buildings are located, consisting of machine shop, engine house, station house, warehouse, freight shed and oil house. A large combined station and freight house has also been completed at Bridgeport. Temporary station and engine houses have been erected at Gowrie mines.

It is the present intention of the company to have the whole road completed and ready for traffic by the middle of June.

A coal shipping pier 1,400 ft. in length with approaches, and in height 45 ft. over the water, was well under way towards completion at the end of the year. There is no doubt this will be finished before, or as soon as the road is ready for traffic.

New Coal Cutting Machine.

We take pleasure in illustrating a new coal cutter that has recently been placed upon the market by the Jeffrey Manufacturing Company of Columbus, Ohio. This Company, as is well known, has, ever since the advent of coal mining machinery, taken the lead in the manufacture and designing of this class of machinery. As will be seen from the illustration, this machine is excellently constructed; its strength, lightness and compactness appealing to the observer at once.

Many attempts have been made to design and build a successful coal mining machine to work on the principle that this one does, that is, with an endless chain or belt, carrying the knives or cutters mounted on a travelling frame, but it had been left to the Jeffrey Manufacturing Company to place on the market a machine that has proved by long and hard experience that it has all the qualities that are necessary to perfect success. As will be noticed, the chain on this machine is inside the stationary bed frame, affording the greatest protection to any one that is working around the machine. The chain belt runs in a perfectly fitting guide which prevents any undue vibration or side motion, which, in turn, insures freedom from breakages or fouling of the cutters in the stationary parts of the machine. It will also be noticed that this machine has a peculiarity that is not common to any other machine and which the Jeffrey Manufacturing Company has taken great care to protect. The chain belt travels on a perfectly horizontal plane, so that only the cutters on the front of the cutter-head are attacking the coal.

The motor of this machine has been designed especially for mine service; the fields form a perfectly tight and dust proof case for the working parts of the motor. Access is obtained to the commutator and brushes by raising a lid in the top of the motor casing. This lid in itself being part of the magnetic circuit, and when the machine is at work, is held down tightly by the magnetism of the field. The switch is also enclosed in an air-tight box so that any sparks from the breaking of the circuit will not be able to reach any dust or gas that may be in the vicinity of the machine at the time. The switch itself is so arranged that the man in starting the machine must move gradually and slowly to the point where the full current is put on the machine. He can not leave it at any point half-way; if he does so, it will immediately fly back and break the circuit. At the end of the fut the man breaks the circuit by pressing a large button which frees the starting wheel and lets it fly back rapidly, breaking the circuit at once without producing excessive sparking The armature of this machine is so designed that any coil can be replaced inside of half an hour at the mine. This is a great advantage to mine operators, as it saves them the necessity of sending the armature back to the factory to be repaired and the accompanying delays and expense. It may be stated in passing that, with the exception of four or five pounds, all the material used in the construction of this machine is either hammered wrought iron, cast steel or bronze.

The use of such material is expensive, but the Jeffrey Manufacturing Company have learned by long and extensive experience of the work that such machinery is called upon to do, requires the very best quality of material that money can buy and the highest class of workmanship that can be procured. This machine is considerably lighter than the cutter-bar machine, which has met with such great success in the coal mining districts of Ohio and Pennsylvania. The motor will weigh seven hundred (700) pounds less, which will give a good idea of the relative proportions in regard to the weight of the two machines. The Jeffrey Manufacturing Company are turning out these machines equipped with electric motors as well as compressed air engines.

Electric Haulage.

So many articles and papers have been written and published from time to time during the last few years on the various systems of haulage for mines, that it is hardly necessary to commence again and give in detail a description of the various systems and their advantages. It will be sufficient to mention briefly the advantages possessed by electric haulage over other systems. Like all other improvements and innovations the application of electricity for power purpose in mines, has met with much opposition, resulting, as it always does, in bringing to a greater degree of perfection, the machinery, and to-day it may be said that the question of electric haulage for mine service being a success is no longer discussed, but is an accepted fact. This is shown by the large number of plants that are being installed throughout the various mining fields, both in this country and in Europe.

The accompanying illustration is of a new type of electric locomotive, recently brought out by the Jeffrey Manufacturing Company, of Columbus, Ohio. The locomotive, it is said, possesses all the requirements that have been shown to be necessary during the long experience of this company in the designing and manufacture of mining apparatus. Its appearance appeals to the practical mine operator at once as being in all respects just what is necessary for mine service, it is compact, strong, simple in arrangement and accessible, with very few parts that can get out of order, reducing the liability to delays and shut downs, which has been the great trouble with many of the locomotives designed in the past. One of the greatest advantages obtained by the construction adopted by the Jeffrey Manufacturing Company, is the interchangeability of parts on the locomotive; everything is in duplicate, or in other words, there are two locomotives combined in one, giving twice the power and requiring a very small number of supply parts for repairs.

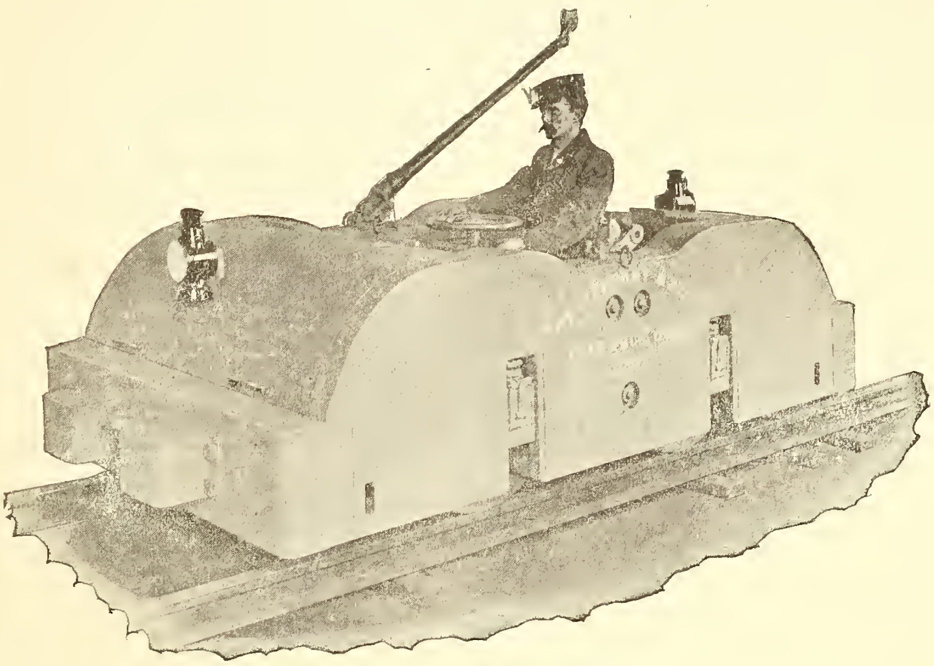
This locomotive is built in three sizes—40, 60 and 80 horsepower; the latter size is the one illustrated. The weight of this locomotive is 19,000 lbs.; length over all, 10 ft. 6 in.; width, 64 in. for a 42 in. guage; height from rail, 32 in. It can run on a 30 lb. rail without excessive wear on the track, as 80 per cent. of the weight is supported on good flexible springs, making it impossible to hammer the track, as is the case where no springs are used or where connection rods are used between the axles. The comparative small dimensions of this locomotive enable it to be used where any ordinary mine car can be used. It is short and has a small wheels base, enabling it to go around sharp curves without excessive friction on the rail. The height of the locomotive being only 32 in., a man can pass without cramping through places 42 in. high. This is one of the most important features, as in low seams a large amount of the roof has to be taken down to admit mules for hauling. Where the roof is of sand rock this is very expensive; instances have been cited where a saving of $3 per yard has been made by using locomotives. The locomotive can pick up the trip from any part by simply throwing the switch leading to it, and if necessary it can be used for switching and delivering any car, irrespective of its place on the trip, to any branch. An extension of the haulage system can be made by simply carrying out the wire, without interfering with the rest of the system. There are no sheaves to be taken care of; no constantly increasing dead load to carry.

The locomotive illustrated is rated at 3,000 pounds draw bar pull at 8 miles per hour, but has been tested on a dry rail and showed a draw bar pull of 5,000 pounds, with sand this can be raised to 6,500 pounds draw bar pull, giving a very powerful starting locomotive, enabling the operator to get his trip up to speed very quickly and without any jarring or throwing the coal off the cars. It is stated that on the level this locomotive has pulled, at a speed of 8 miles per hour, 65 cars, each car containing 3,000 pounds of coal and weighing 12,000 pounds, making in all a trip of 136 tons. At this mine the coal is being hauled for 1¼c. per ton per mile; before the haulage system was put in, counting in dead work necessary to admit mules, the cost was 7½c. per ton per mile. This plant paid for itself the first 14 months. The Jeffrey Manufacturing Company have orders for a number of these locomotives, both for the anthracite coal district as well as the bituminous district.

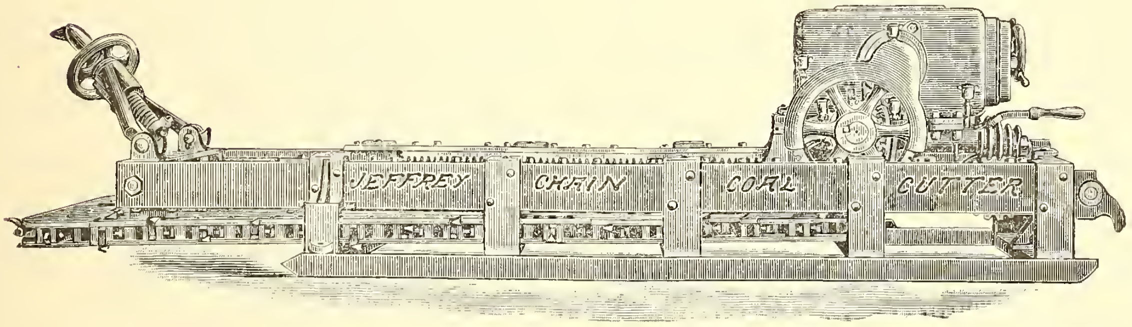
Elliott's Patent Coal Washer.

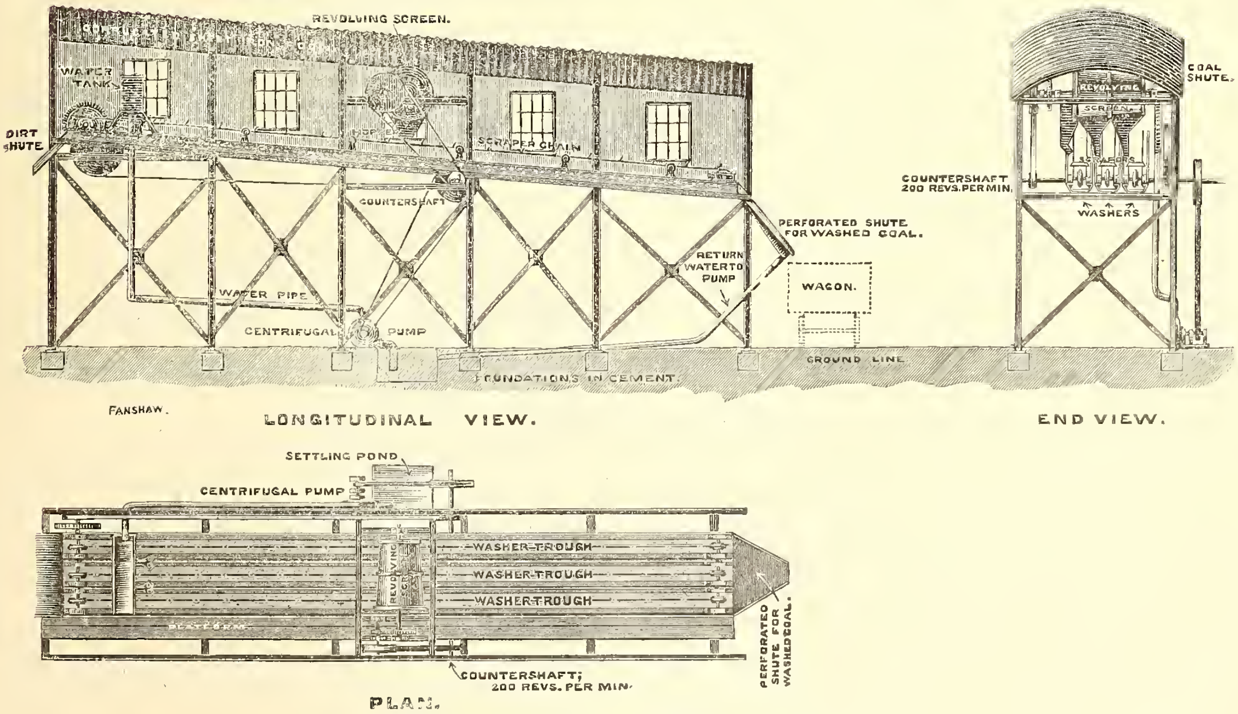
We take pleasure in furnishing our readers with a description of a new coal washing machine now being pushed by the well known English manufacturers, the Hardy Patent Pick Co. of Sheffield.

This machine has been designed on the lines of the old trough washer which has long been a favorite with many colliery engineers on account of its simplicity and its efficiency when in the hands of an intelligent, trustworthy attendant. But in addition to the difficulty of always obtaining the necessary skill and attention, there was also in the old troughs the necessity of changing the flow of coal and water into a second trough while the dirt was being washed off and removed from the first when the stops had become charged with it; for if this was not done at the proper time some of the dirt became mixed with the coal and the result was not satisfactory. The Elliott Washer is automatic in its action and retains all the advantages of economy and efficiency of the old trough, without any of its disadvantages, and is independent of the skill or attention of the attendant, the operation of washing proceeding without interruption as long as required, the coal being delivered at one end of the trough with the water, and the dirt at the opposite end. The washer is constructed with a wrought iron or steel trough about 18 in. wide, having sloping sides, being widest apart at the top and narrowest at the bottom. At each end of this trough a sprocket wheel is fixed, on which a chain rides, and attached to the chain at suitable distances are scrapers at right angles to it, and which correspond with the inside shape of the trough. The scrapers form moveable stops or dams which are slowly moved by the



Jeffrey Electric Mine Locomotive.





Elliott's Patent Coal Washing Plant.

chain along the trough in the opposite direction to the way the water runs. The trough is fixed at a suitable inclination, and the coal is admitted at the centre of its length and the water at its highest end or thereabouts, and as it runs to the lowest end it carries with it the coal, which is lighter than the dirt, and the dirt settles in the scrapers and is conveyed by them against the stream of water and delivered at the opposite end to that which the coal escapes. The speed of the scrapers and quantity of water regulated to suit the material washed. The result is equal to that of any washer known, without exception, and has been described by users as the perfection of simplicity and efficiency. The water is circulated and used continuously, so that the waste is that only which is carried away by the dirt and coal after drainage. A centrifugal or other pump is used for elevating the water to the washer. One man can attend to as many troughs as may be required for any output.

Enormous quantities of small coal have to be disposed of at a very small or nominal price on account of the large percentage of shale and dirt which is mixed with it either in its formation or in the process of getting, the coal itself being of good and useful quality either as a fuel or for the manufacture of coke. The usual and most efficient mode of separating the coal from the dirt is by washing. In all washing arrangements the difference of the specific gravity of the coal and the dirt is taken advantage of to effect a separation. The coal being the lightest is carried away by the water and the dirt collects at the bottom of the washing apparatus and is afterwards removed by some suitable device. In the manufacture of coke it is essential that the coal should be as pure as possible, so that the ash may not exceed, say 5% to 6%. In addition to this, the shale or dirt having no coking qualities, but the reverse, it prevents the coal from forming a strong homogeneous mass or, in other words, it causes the coke to be unable to support much weight of iron in the furnace, instead of being strong and hard. Instances have occurred where the coke made from unwashed coal has been so tender and contained so much ash (15 to 20%) that it was quite unsaleable, and after washing and grinding the ash was reduced to 5% and the coke commanded a ready sale, being equal to any other in the market. In the manufacture of briquettes also, it sometimes happens that colliery proprietors turn to this means of trying to dispose of their slack at a profit, and doubtless are disappointed at the prices obtainable chiefly on account of the large amount of ash contained in the briquettes and the dirty and sluggish fire made with them, whereas if the coal had the dirt separated from it, the result would be very different. The necessity of this separation of dirt from coal is evident, but many colliery proprietors prefer to struggle on as best they can rather than be saddled with one of the expensive or ineffective plants that are in use at some pits. The enormous first cost, the cost of repairs, the unsightly mses that is often seen, as well as the necessity of preventing the pollution of streams, are enough to prevent many firms from availing themselves of the advantages of a washing plant. But when these objections are removed, as they are in the Elliott washer, quite a different light is thrown upon the question. By using this washer, the first cost is the smallest possible. The repairs are practically *nil*, the water is not allowed to escape, being used over and over again, and the cost of washing is reduced to about 2d. per ton, including loss in weight. The coke produced by this machine is greatly improved in quality and structure, and, from being unsaleable, commands good prices; and in some cases the value of coal has been increased from 2s. 6d. to 3s. 6d. per ton. Briquettes can be made of washed slack to sell at the same price as best coal from the same seam. Steam coal slack can be made into small blocks to give as good results as the best large coal from the same seam, and in each case leave a good margin for profit.

A Rocking Granite Boulder.

Rocking stones are not as uncommon as most people think. A number of them have been referred to as existing in this country, but they have been mostly boulders of sandstone, limestone or gypsum. We do not remember having heard of a granite "rocker" before. The erosion caused by wind, water and sand on the softer stones has left many of these natural curiosities, but these elements have not often shown their effect on granite boulders in this remarkable manner. We are indebted to Mr. John Kline, Jr., of Halifax, N.S., for photograph of the illustration herewith shown, and for the description of the curiosity. The boulder is on the property of A. Kidston, Esq., near Spryfield, N.S., about five miles west of Halifax. The boulder is estimated to weigh 464 tons. When first discovered it would rock in the wind, but since it has worn on its bed it takes a strong push to start it. It was found by a fisherman, who when a heavy storm came up on the lake near by, sought shelter beneath its projection on the lea side. Its rocking under the pressure of the wind caused him to seek a safer retreat. After the storm blew over he investigated the phenomenon and himself easily moved the mass in any direction. The rock is one of the objects of interest to visitors to Halifax.

Electrical Mining Machinery.

Electrical mining machinery will be to some, perhaps, who five or six years ago were venturesome enough to equip their mines or quarries with complete installations, an unpleasant topic because of its failing to do then what they expected, meaning in many cases a severe monetary loss and rough set-back to their ambition to have the most up to date appliances; their disappointments, too, being increased when part of the installation is remembered as a success and was desirable, but owing to the failures of the remaining parts, too expensive to operate.

The manufacturers, too, who sank vast amounts of their capital in striving to construct apparatus that would stand side by side with steam or compressed air apparatus and prove itself even of greater value, went unrewarded, almost before trial, yet knowing that these latter rival forces had not been perfected in one or two years but had taken thirty or more, and adding this knowledge to their slight success they plodded on, meeting with more encouragement each time owing to better construction of apparatus and the employment of men capable and willing to work for their employer's success. With success came competition, and such companies in the United States as the Edison, Thomson-Houston, Westinghouse, Jeffrey, and Sperry, zealously guarded the methods they adopted in the construction of their apparatus, one company going as far as to keep an able superintendent and seven or eight skilful mechanics working in entire seclusion from the rest of their employees, supplying them with every requisite in the form of tools and material; huge blocks of sandstone, lime, granite, rocks and coal being given them on which to make experimental tests, careful records of all being taken, proving a most valuable reference and aid.

On the completion of a mining machine it was sent out under the care of one of the men who had assisted in building it, put in operation in some mine or quarry by a pre-arrangement with the owners, and there operated until its defects were exposed, when it would be again returned to the works with a careful record of its failures and success.

The amalgamation of the Edison and the Thomson-Houston Companies, now known as the General Electric Co., and the arrangement of this latter with the Sperry and Jeffery Companies has resulted in the rapid development of electric mining apparatus to such an important extent that the mines and quarries in Canada and the United States are being rapidly equipped, some operated by water power many miles distant, transmission of 20 or 30 miles being secured with economy. The Canadian General Electric Co., being closely connected with the General Electric Co. of the United States, are thus enabled to supply any type of mining machine made by the latter, and with their own successful installations now in operation they rightly feel that the success of electricity in mining is no longer an experiment but an assured fact. When a huge electric street car 45 feet in length, loaded vastly beyond its capacity, is seen rushing past and it is realized that the source of energy comes from a copper trolley wire about ⅜ in. diameter and conveyed to the motors through the medium of a 4 inch trolley wheel, the successful operation of every form of mining machine can no longer be doubted, for the strain upon street railway apparatus is as severe if not more so than in mining.

The precautions of looking out for pin hole leaks in compressed air pipes can now be avoided by the adoption of electrical energy conveyed through wires or cables. The necessity of shingles and packing to keep the steam pump going, overcome by motor driven pumps; cruelty to horses and mules by their barbarous boy drivers done away with by the use of powerful electric locomotives of 70 or 80 h. p. that can be operated in entries as low as four feet high, drawing as many as 30 cars and all under the operation of one man. Again, in place of tedious hand drilling in coal or coal or gypsum, electrical auger drills can be had, small and compact, total weight with jacking frame being about 100 lbs. These drills can penetrate, with a 1½ inch auger bit, ordinary bituminous coal at the rate of 6 feet per minute. Two small insulated plugs of 1½ inch diameter attached to a flexible ¾ inch armoured cable leading from the two main wires furnishes the required energy. Should unyielding substances be encountered a friction band encircling the feed screw nut, allows the nut to revolve which in turn prevents the auger feeding forward, although it may still be revolving. For under cutting coal, an electric chain cutter, cutting 3 feet wide and 4½ feet deep, its motor designed for quick reversing and made to withstand the rough usage too often met with in mines.

In rock drilling the steam and air drills have a worthy rival in the electric percussion drill which, though somewhat heavier, can claim the merit of being much simpler in construction, requiring no packing about its piston of solid forged, plainly finished steel. A similar rifle bar to that of the Ingersoll Sergeant drill is used, and similar also is the manner of protecting the front head by buffer springs fixed at the back head. The reciprocating motion is controlled at the generator, length of stroke of drill being regulated by feed handle. A valuable point in this drill's favor is its strong up pull, an excellent feature in mud holes.

Like the auger drill, an armoured cable 1½ in. diameter furnishes the energy, and the substantial gun metal insulated contact piece at the drill end of cable makes the contact and is so constructed that it will remain in place when drill is stopped and if desired can be readily withdrawn and thrown down or handled with impunity. With no exhausting of steam or air, the electric drill merits for this reason alone special attention, though sometimes exhaust air is desirable in tunnel work.

Motors are so well known that to mention their usefulness would be superfluous yet the latter types called induction motors demand attention inasmuch as they lack brushes or commutators, two valuable features, are dust proof and self oiling, extremely powerful to start under full load and are at all times absolutely without spark. When it is known that a motor can be used to operate a small repair shop many hundred feet under ground and save taking a machine apart to get it to the surface for repairs and that the required energy to operate the motor can be furnished by means of a pair of insulated wires flexible and safe; this with the many other purposes that motors may be used for, and, adding to the useful machines already mentioned, ought surely to release electricity from the time worn statement that it is yet in its infancy, and that electricity in mining and quarrying can claim truly repaid progress.

Electric Percussion and Rotary Drills.

Electric rock drills have been introduced at various mines in Canada, the latest and most improved installation being the type of portable electric percussion and rotary drills put in at the Windsor Gypsum Quarries, N.S., by the Canadian General Electric Co. of Toronto.

The percussion drill in general external appearance conformes very closely to the regular type of steam and air drill; in fact the tripod and shelf are of the standard steam drill form. Electrically, it is arranged in the form of a solid piston reciprocating in a magnetic field and controlled thereby. The piston is provided with a standard air drill rotating rifle-bar and the usual form of springs to protect the front head of the drill from blows. The drill has a piston diameter of 3¾ in., a length of stroke of from 6½ in. 8½ in., length of feed 24 in., number of blows per minute, 360 to 380.

The first of these drills was installed on the Canadian "Soo" canal last winter, when the contractors, Messrs. Hugh Ryan & Co., were greatly pleased with its performance. On these works the performance was equal to that of a 3 in. steam drill, and the facility with which the drill could be moved, owing to the complete flexibility of the connections, was especially remarked. As far as economy goes, it far surpasses any other drill on the works. The cost for operating including power for operating the generator and labor of the attendant at the power house, was somewhat under the average operating expenses of the steam drills. In the Windsor Gypsum Quarries, Windsor, N.S., where one of these drills is in operation, every satisfaction is given by it. The best days work of one drill on record is ten 10 ft. holes in nine hours and twenty minutes. This was in glow lime stone.

The rotary drill is designed especially for use in coal mining, but has also been used with great success in the gypsum quarries of the Windsor Gypsum Co., where the clayey nature of the material tends to clog the drill and imposes the severest test on the capability of the machine. The drill is similar to the well known Howell's drill with an electric motor geared to it in such a way as to form a light and efficient tool. The control of the motor is effected by a small plug switch. No rheostat is used, and power may be taken from the same wire supplying current for lighting, pumping or haulage.

Feed screws of different pitch are furnished for varying the speed of boring and a friction clutch protects the motor should any particularly hard obstacles be struck suddenly. The columns are made in different lengths and each is adjustable for about two feet variation. The constrnction of the drill and its method of mounting enable the operator to drill close to the roof, floors or wall, as well as in any direction. The drill weighs with post complete only about 160 lbs., the drill itself weighing 100 lbs. In bituminous coal this drill shows a speed of drilling of 7 to 10 ft. per minute.

Long Spans in Screening Structures.*

WALTER H. MUNGALL, B. Sc.

To all who are practically interested in the screening and loading of coal into waggons it must be evident how great a source of danger, and unfortunately occasionally of accident, are intermediate supports between the several lines of railway. The old-fashioned square wooden posts have in many cases been superseded by iron columns of smaller dimensions, this leaving greater clearance between them and the passing waggons, and in a few instances intermediate supports have been entirely discarded.

To avoid intermediate supports necessitates the adoption of long spans, and as we increase the load that a given beam will safely carry, or, in other words, for an equal load we must increase the dimensions of the beam. In all screening structures not only is sufficiency of strength of the various parts of the highest importance, but strength must be accompanied by a certain amount of rigidity. With simple beams the span that can be attained is necessarily limited to short distances, not merely because the load a given beam will carry with safety varies inversely as the distance between the supports, but more especially because the rigidity of a beam varies inversely as the *cube* of the distance between the supports. Thus a beam with a given span has a certain strength and a certain stiffness, while if we double the span the same beam, similarly loaded, will carry with equal safety, half the load, but the rigidity will be only one eighth of what it was with the shorter span. From this it is evident that to increase the span even by a small amount necessitates, with a simple beam, a considerable increase in the dimensions of the beam. The stiffness of a beam may, however, be increased beyond that of its natural state by exercising its own elasticity. For example, in the case of a beam to be fixed between the walls of a building, its stiffness may be increased by firmly propping it in the centre a little above the normal position it is to occupy when loaded, and then bending the ends down to the proper level, when being built into the walls. Its elasticity will thus be partially used up and its stiffness considerably increased when the central prop is removed. It is only in very few instances, however, that this method can be applied in screening structures. When longer spans are required than can be readily attained by simple beams, trussed beams are usually employed. With fixed bar screens, loading direct into waggons, spans of about thirty feet with trussed beams are common.

The same system has been adopted in some modern plants, and in one instance, with which the writer is familiar, there is a clear span of sixty feet over the lines of railway. The plant referred to consists of a series of fixed bar screens, with relative distributing bands, picking bands and conveyors. The platform on which the picking bands and conveyors are built is suspended by iron rods from trussed beams overhead; and by suitable bracing the whole structure is rendered perfectly rigid. Those overhead beams are supported at one end on a brick building, and at the other on columns formed of old 60 pound rails. The beams, which are of pitch pine, fifteen inches deep and seven inches broad, are laid in pairs and trussed as one with a space of 2½ inches between. Through this space of 2½ inches the suspending rods already referred to are passed, being fitted to suitable castings, fitted on the top of the beams.

It is not necessary here to go into the methods of calculation of the different stresses in the various parts of trussed beams, the object being rather to indicate how the danger of intermediate supports between the lines of railway may be avoided.

*British Society of Mining Students.

A New Blasting Tool.—In blasting coal and rock the explosive should be so placed that its full force may be expended in forcing out the greatest amount of material possible. To effect this result it is often difficult, and sometimes impossible, to drill the shot hole in the right position. This difficulty occurs in blasting coal and in driving tunnels, where the holes drilled are mostly breast holes. To overcome this difficulty, and enable all the explosive to be got behind its work, the patent excavator or chambering tool has been designed, and its value for breast holes in tunnelling and in blasting coal will be evident to those accustomed to this work. It is used as follows:—After the hole has been drilled by means of one of the ordinary hand-boring machines now almost universally used in mining, the excavator or chambering tool is inserted and used in the same way as a drill, but with a slower advance feed, and the pressure on the two loose cutters causes them to open and cut out a chamber. The cartridge of powder is then inserted, rammed home, and burst in the chamber where the powder lodges. The tamping is done in the usual way. It will be seen that this chamber enables all the powder to be put behind the material to be blown out, and also offers the largest area for the gases of the powder to act upon in a direction at right angles to the direction in which the hole is drilled, as well as a large surface in a line with the hole. It is claimed that in blasting coal with this system from two to four times more coal can be dislodged by the same quantity of powder employed in an ordinary hole in a breast shot. The hole is drilled as deep as the coal is holed, and the full force of the blast acts at the back and spreads for a long way parallel to the face of the coal, thus pushing it off towards the face. The Hardy Patent Pick Company Limited, of Sheffield, England, are introducing the tool.

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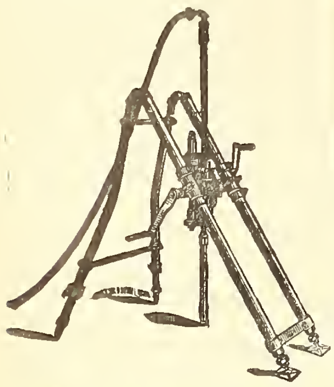

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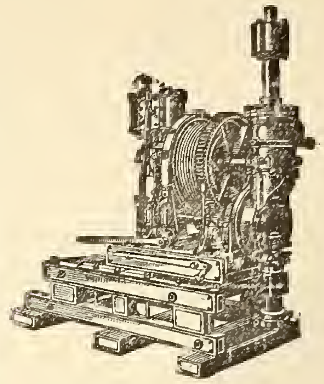

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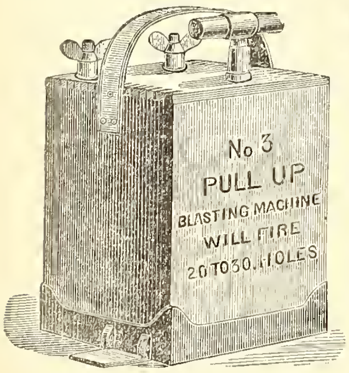

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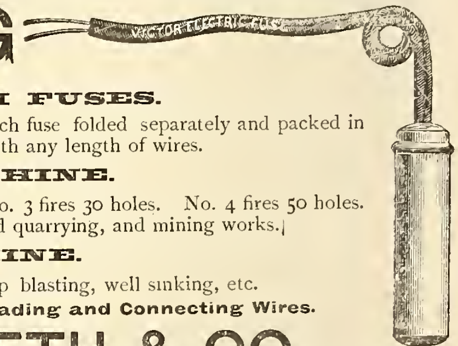

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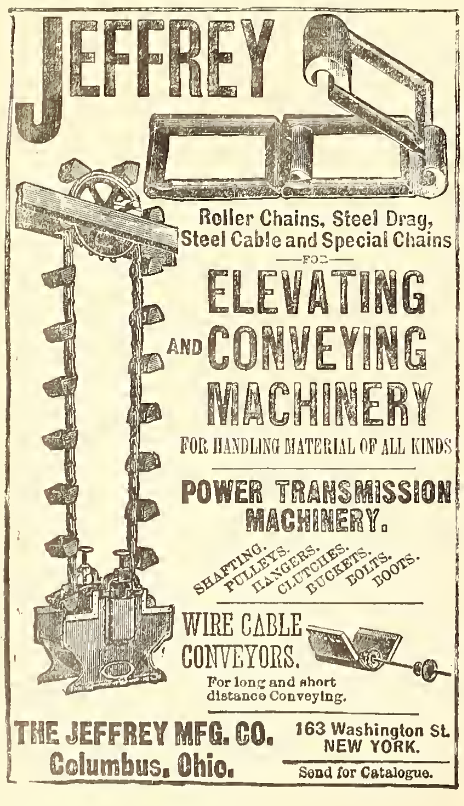

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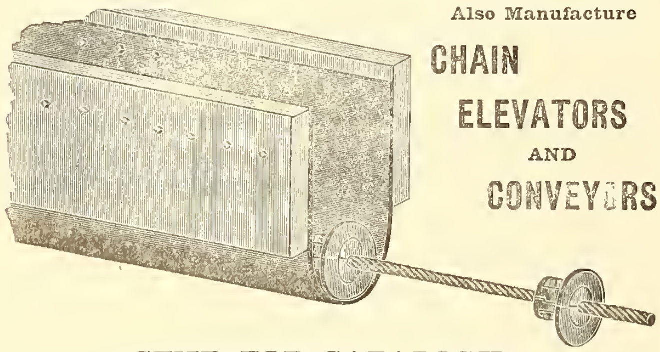

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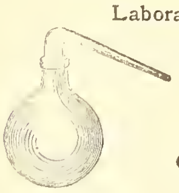

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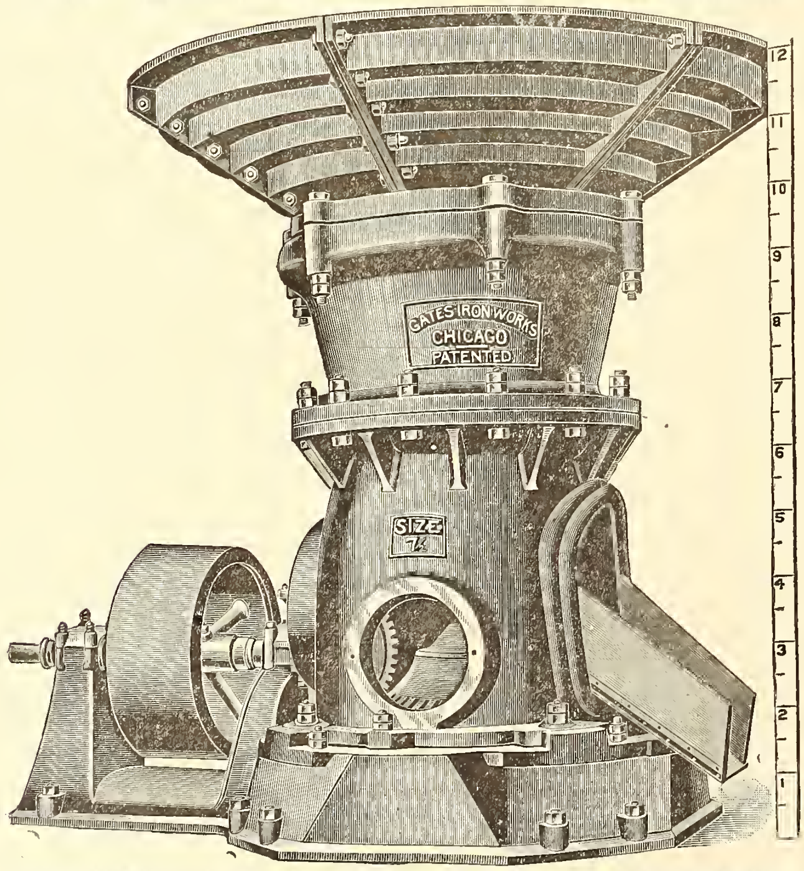

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The Mineral Resources of Cape Breton.

Whenever in Cape Breton the exigencies of the moment require a speech from a politician, a visitor or a lecturer, and like all English-speaking people those of Cape Breton are as fond as any others of a speech, there never fails a reference to the mineral resources of the Island. They are painted in glowing colors, and the listeners hear of every mineral in overflowing abundance; so much so, that the enquirer is often disappointed and unfavorably impressed when he learns that outside of coal these below-ground treasures have hardly been touched. It may not be out of place here to enquire briefly into what substratum of fact there may exist to warrant the glowing prophecies of the well-wishers of the Island.

In this connection allusion may be omitted to the coal fields, beyond remarking that while coal is extensively worked in the Sydney district, there are several other valuable but undeveloped districts.

There are in Cape Breton two geological points which specially present mineral values. The Island is made up of several large and isolated masses of felsitic-gneissic rock, which with granites, altered slates, limestones, etc., have been considered equivalents of the Laurentian strata as typically developed in Quebec, etc. The largest of these masses occupies many square miles, covering nearly all the county of Victoria and the northern part of Inverness. There are also smaller masses in the southern part of Inverness county, in Richmond, and covering the greater part of the county of Cape Breton.

These masses are fringed by and connected by means of strata belonging principally to the lower divisions of the carboniferous. Roughly speaking, this is the skeleton of Cape Breton geology. The mineral horizons in these strata present themselves in part of both of these divisions, and in a marked manner at the points where they are in contact. As may be readily gathered from a glance at a geological map of Cape Breton, these lines of contact are extremely numerous, the narrower masses are lapped on all sides by the newer strata, and the larger masses have long narrow tongues of carboniferous penetrating them for many miles.

These points of contact present manganese ores, iron ores, and when limestones are present the vicinity of the junctions sometimes show ores of lead and copper, veins of barytes, fluor spar, ochres, etc. A district exhibiting strongly these signs of mineral wealth is that of Loch Lomond on the line between Richmond and Cape Breton counties. Here manganese ores are present in quantity which has warranted working, drift iron ore of good quality is abundant, and there are veins of fluor and barytes spar. Along the same line of contact, on the Salmon River, some limestone bands show galena. As yet, however, the manganese alone has received practical attention. The district showing a similar junction from a point some miles north of Cheticamp southerly to the Margaree River yields ores of manganese, iron, and copper. A similar state of affairs exists at numerous points along these lines of contact, and specimens of iron ore, etc., are frequently shown as evidence of unsought value.

In the carboniferous itself are presented enormous deposits of gypsum, outcropping at numerous points, as yet, however, but sparingly quarried at Port Bevis, Grandique and Mabou. The present demand for this mineral, about 150,000 tons, is met by shipments from Windsor to points in the United States. The shipments from Cape Breton, amounting to some 30,000 tons, are to points up the Gulf of St. Lawrence. The future capabilities of this mineral in connection with the fisheries, for the manufacture of fertilizers, etc., should be very great. This horizon yields also abundance of limestone, some of which is adapted for building purposes, and a few tons are annually burned for lime for local use. The source of the exported Cape Breton lime will be referred to further on. There are also known in this formation indications of the presence of deposits of barytes, of lead ore, and of manganese. The brine springs, which have of course great local fame for curative purposes, may be viewed with interest as possible indications of the presence of salt beds. Minerals of the borate family have been observed in the Cape Breton gypsum. In fact, so far as any attention has been paid to the gypsum-limestone localities of Cape Breton with their associated marls, brine springs, etc., there is good reason to believe that they as well as their kindred localities in Nova Scotia proper would in several ways amply repay the attention of capital associated with mineralogical skill. The occurrence of gypsum marks a period of peculiar selective and concentrative chemical energy in the geological sequence which has given great value to certain localities in Europe, and is now being utilized in parts of the Western States of the American Union It may be added that recent explorations have shown that these measures also yield good building stones, varying in color from red through brown to white, composed of quartz with in many cases a silicious cement. It may be questioned if anywhere in Canada there is a geological horizon so little studied and yet so rich in what pertains to the builder, the miner, the farmer, and the chemical manufacturer.

Our brief review now passes to the older rock masses, the foundation and back bone of the island. At several points are known iron ores, specular, red hematite and magnetite; only a few trenches, however, reveal to us any knowledge of their economic values. At numerous localities drift iron ore promises other deposits, associated with the limestones or penetrating the felsites, etc. In the great mass of granites, felsites, gneisses, etc., covering most of Victoria county, are localities yielding mica, which, although not yet found in workable masses, is certainly promising for further search. Indications of copper ore deposits are widespread, and undoubtedly some of them must be valuable. At Coxheath the work of the past few years in opening up what appeared at first of comparatively little value, has shown that the island contains large bodies of workable copper ore, sometimes enhanced in value by silver and gold. These older rocks also contain shales apparently valuable for plumbago, and by analogy should also carry graphite and phosphates. The latter mineral, as found in the form of apatite, is not at present an export of value from Canada, but if it can be utilized anywhere in the Dominion, Cape Breton would be the place. The limestones of this formation are in places metamorphosed into marble, which is now being placed on the market from West Bay. At this point large quantities of lime are burned, and search may show beds suitable for cement-making, etc. Gold also occurs in these strata, but has hitherto received little attention.

Such, briefly, are the indications of the mineral wealth of the island, and the list is an encouraging one. Remoteness and inaccessibility as well as the attraction of older and better known regions, has diverted attention from its mineral resources. Now, however, ready railway and water communication permits of facilitated investigation, and it may be safely said that no district in Canada of equal size, presents equal inducements for the prospector, equipped with proper geological and mineralogical knowledge.

Gold Mining in British Columbia.

In the summary report of the operations of the Geological Survey, for the year 1894, issued this month, Dr. George Dawson, C.M.G., contributes a valuable synopsis of his recent investigations in the placer fields of Cariboo. So much interest is being taken by capitalists in this district that we cannot do better than quote what he has to say in full:

"Although hydraulic mining has long been practised in the Cariboo region, it has hitherto been on a comparatively small scale, and confined to the immediate vicinity of the older mining camps. The isolation of the district from main lines of communication has limited enterprise in this direction almost entirely to what could be done with local resources. During the past summer, however, work on a much larger scale has been actually begun in several places, with results, so far as it has gone, of a very gratifying character. Capital has been interested in this expansion of hydraulic mining sufficient to meet the heavy initial expenses of long ditches and pipe-lines with the most approved modern appliances. These operations have already drawn general attention to the extensive gravel deposits of the Cariboo region, which, although less rich than the old channels originally worked by drifting, are enormously greater in area. The country, as a whole, is one well supplied with lakes and streams at every different level, and thus well suited for the hydraulic working of any of the gravels which may prove to be of a payable character.

"It is but just to add, that the present renewed interest in the Cariboo district is very largely due to the practical knowledge and advice of Mr. J. B. Hobson, who is in charge of the works of the Cariboo Hydraulic Mining Co., and of those of the Horsefly Hydraulic Mining Co., both of which it is anticipated will be in full operation early next spring It is certain that extensive prospecting work will be carried on next summer in various parts of the district, and it is therefore advisable to give here, some of the more important facts already determined which may be of service to the prospector. During my short visit to the district, attention was chiefly given to the developments made by the two companies above named, and some notes on these will first be given. The places referred to will be found laid down on Mr. Bowman's map of the Cariboo mining region, published with the Annual Report of the Geological Survey (new series) vol. III.

"The property of the Cariboo Hydraulic Mining Co. is situated on the south side of the South Fork of Quesnel River, about three miles above the village of Quesnel Forks. It comprises several claims and is believed to cover about 8,500 feet of an old high channel of the river, separated from the modern, deep, and canon-like river gorge, for a considerable part of its length, by an exposed rocky ridge known as French Bar Bluff. Near the lower end of the property, on Dancing Bill Gulch, successful hydraulic mining, on a small scale and with imperfect appliances, has been been carried on for a number of years by a Chinese company. At a distance of about 3,000 feet further east, on Black Jack Gulch, a good deal of work had been done by the South Fork Co., but without effectively reaching the richer gravels, which are below the level of the rim rock where this has been cut through. Short ditches had been made by both these earlier companies, and the exposures in their hydraulic pits afford most of the information obtainable as to the character of the deposits. A ditch with a total length of seventeen miles. and a capacity of 3,000 miner's inches, has now been laid out by the present company and will be completed in the spring. This is to derive most of its water from Polley's Lakes, situated in the hills to the south-eastward. It is also, I believe, ultimately proposed to bring an equal volume of water from Moorhead Lake, by means of a second ditch which will be thirteen miles in length.

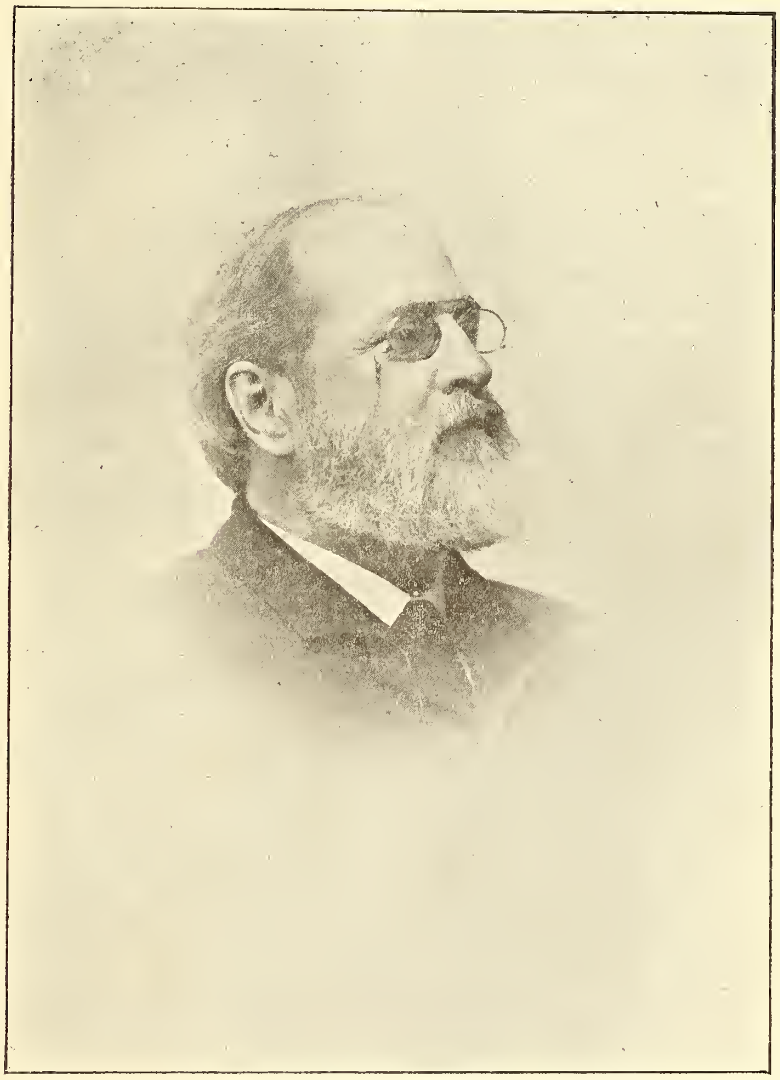
"At the lower or "China pit" the bed-rock of the old channel where cut by the present river bank is believed to be approximately 134 feet above the river. The head of the train of sluices near the working face is 200 feet above the same datum, while the sand box at the top of the bank is at a height of 489 feet; giving a head of water equal to about 289 feet, with ample fall for the dump, which is made direct into the river. Two monitors of five and five and a half inches diameter of nozzle respectively, are established in this pit. Mr. Hobson estimates that the old Chinese company removed in all, about 150,000 cubic yards of the bank, from which, it has been ascertained, $135,000 of gold was obtained, without the employment of mercury, being at the rate of about 90 cents per cubic yard. The scanty water supply available in advance of the completion of the main ditch, enabled a run of only forty-seven hours to be made in the early summer. The mean volume of water employed was 2,000 inches and the yield was 302 ounces.

"The floor of the pit of the old South Fork Co. is about 200 feet above the present river, and bed-rock has been found in test pits at a depth of about 30 feet below this floor, while above it, on one side of the gully, is a nearly vertical face of clay and gravels about 200 feet in height. The head of water from the sand-box to the present bottom of the pit is about 246 feet; but as already stated the rim rock has not yet been cut through to the full depth of the old channel. It is proposed to begin active work here in the spring.

"The geological conditions as displayed in the two pits above described are of great interest, but in the present summary it is possible only to allude briefly to the main facts: In the old South Fork pit, the section in descending order, shows: (1) Ordinary boulder-clay with many glacially striated stones, 60 feet; containing little or no gold. (2) Stratified sands and gravels 120 to 130 feet; yielding gold to the amount of about five cents to the cubic yard. (3) Hard 'lower boulder-clay' with very few glacially striated stones, 30 feet; not known to contain any gold. (4.) Well ronnded gravels, to bed-rock, 30 feet; rich in gold, some prospects obtained from trial pits being as high as $20 to the cubic yard

"In the 'China pit' the section exposed is as follows: (1) Stratified gravels, seen along a portion of the top of the face only, greatest thickness about 30 feet. These contain gold to the amount of about five cents to the cubic yard. (2) Boulder-clay about 100 feet thick, in what appears to represent the axis of the old channel, but running out to nothing on each side; not known to hold any gold. (3) Rather hard roughly stratified gravels and sands, with clayey matter; the stones well rounded and often large. Maximum thickness about 310 feet to bed-rock, minimum thickness (where the overlying boulder-clay is deepest) about 200 feet; rich in gold.

"The gold content of the several deposits, as above stated, results from tests made by Mr. Hobson and communicated by him to me. The equivalency of the strata in the two pits is not quite certainly determined but No. 1 in the 'China pit' is believed to represent No. 2 in the 'South Fork pit,' No. 2 to represent No. 3, and No. 3 to represent No. 4 respectively. The bed-rock appears to be generally a much altered and shattered greenstone (diabase?) penetrated by syenitic dykes and including a considerable body of syenite near the 'China pit.' In regard to age, it would appear that the lower and richer deposit in each pit is pre-glacial, while the upper gravels in the 'South Fork pit' (No. 2) are, certainly, and those in the 'China pit' (No. 1) propably, of inter-glacial origin.



Mr. S. M. ROBINS, General Manager,
New Vancouver Coal Mining & Land Co., Ltd.
NANAIMO, B. C.

"The Horsefly River empties into Quesnel Lake at a distance of twelve miles from the outlet of the lake. Its sources are in a mountainous country to the eastward, but its lower part here particularly referred to, flows northward. A good deal of prospecting and some remunerative mining has been done at different times along this river and its tributaries, and the Harper claims have for many years attracted more or less attention as extremely promising, but owing to various difficulties have not been extensively worked. The Horsefly Hydraulic Company's claims, are situated on the river at a distance of about six miles south of Quesnel Lake, and here very important operations have now been initiated. The river was notably rich in this particular part of its length and the bars had all been worked over by Chinamen some years ago. Mr. McCallum, the discoverer of these claims, rightly believed that the modern placers must have some local source of the nature of an old channel. In search of this he endeavored, by ground-sluicing, to work back in the bank of the river, but finding the ground too heavy for his water supply, eventually drifted into the bank and succeeded in striking the old auriferous gravels. These were at first worked by drifting and afterwards with a small hydraulic plant, supplied from Rat Lake, which is now used as a reservoir by the new company. The mining rights of the discoverer were secured by purchase by the Horsefly Hydraulic Company, and in the course of the prospecting carried out for this company by Mr. Hobson, much has since been learnt in regard to the character and extent of the deposit.

"By the system now successfully completed, water is brought from Mussel Creek, a southern feeder of the Horsefly, by a ditch and pipe-line aggregating over eleven miles and a half in length. The ditch is about ten miles long, with a capacity of 20,000 miner's inches. The pipe-line is steel, 30 inches in diameter, in two lengths aggregating 8,300 feet. There is also about 600 feet of flume. From the sand-box the water is led to the pit by two lines of 22-inch pipe, each of which is intended eventually to supply two monitors. Water is delivered from the main ditch with a head of 168 feet, and from the pooling reservoir with a head of 106 feet. The bed-rock constituting a floor of the pit is about 90 feet above the level of the river, and the working face (60 feet in height at its highest part) at the time of my visit was about 560 feet back from the river bank. The dump is formed in the river itself, which is a moderately rapid stream, capable (particularly in high water) of removing a large quantity of debris.

"Respecting the actual average gold content of the gravels, much has doubtless been ascertained since my visit, some $13,000 being reported as the result of the last "clean-up" The preliminary run made by the company, was estimated to have dealt with 21,333 cubic yards of gravel. It produced gold to the value of $5,000, or at the rate of about 25 cents per cubic yard, but about a third of the area then worked had already been drifted on bed-rock by Mr. McCallum, rendering it probable in Mr. Hobson's opinion, that the unworked ground would average about 40 cents. A small quantity of platinum occurs with the gold at this place.

"The bed-rock in the hydraulic pit consists of pale, Tertiary (Miocene or Oligocene) shales, clays, sandstones and conglomerates, only moderately indurated, and, in general, easily removed by the jet whenever this is required. These rocks contain a few fossil plants and insects, and are inclined in various directions, but their upper surface is a nearly horizontal denudation plane. The working face shows, resting upon them, a thickness of from 30 to 50 feet of gravels, roughly stratified, and varying in character in different layers from almost bouldery material to sand. A few feet near the bottom is irregularly cemented, and some parts of this "cement" is so hard that it cannot be disintegrated by the water. The cementing material is chiefly calcite, but strontianite is found in crusts of half an inch or more in some of the interstices. Stems and fragments of wood are occasionally seen in the lower layers, in a condition approaching that of lignite. The general colour of the auriferous gravels is yellowish, but becomes bluish toward the base. They are directly overlain by a regular layer, of from ten to fifteen feet in thickness, of ordinary boulder-clay which except where covered by later gravels, forms the general surface of the country in the vicinity. In another part of the pit, a local deposit of rather fine, gray gravel is found between the boulder-clay and the auriferous gravel, but unconformable to both. This yields a small prospect of fine gold, but the boulder-clay itself is not yet known to hold any gold.

"The auriferous gravels at this place are therefore distinctly pre-glacial in age, and may, with little doubt, be assigned to the Pliocene period of the Tertiary. While it is probable that they represent an old river-channel, this has not yet been clearly demonstrated, nor is it at all certain that they have any intimate connection with the present course of the Horsefly. The problem is one, not only of great interest, but also of great importance in connection with the future development of the field.

"The upper end of the Harper claims, where some work has been done, is situated about four miles further up the river than the last. Small sections, made in the course of work near the river bank, here show yellowish auriferous gravels, precisely like those of the Horsefly claims and capped in the same way by boulder-clay. Several small shafts have been sunk in this vicinity and part of the river bank and bed has been worked by drifting and wing-damming. The Miocene bed-rock is found nearest the surface at six feet below the river level. Though not thick, the auriferous gravels in this neighbourhood have proved to be exceptionally rich, and they appear to be somewhat wide-spread. Some miners were engaged at the time of my visit, in putting in water wheels to drain small open-cast workings on the east side of the river; but for the working of the deposit here on a large scale, the hydraulic elevator would probably be the most appropriate appliance.

"Adjoining the Horsefly claims on the north, is the Thompson claim, where the owner has been engaged for some years in drifting into the bank, with the purpose of reaching the supposed continuation of the depression or old channel in which the auriferous gravels of the Horsefly claims occur. The drift is now about 1,200 feet long. It cuts through Miocene rocks like those already described, somewhat flexed, and including a considerable bed of conglomerate, which I was informed, contains a little fine gold. There is no surface indication to show where an old channel may be expected to pass, and it would appear to be advisable here to test the ground by boring in advance of the drift, before this is pushed further in the present direction.

"The notes above given refer only to localities actually visited by me last summer. I hope to give, at a later date, a fuller account of the various deposits seen, which it is impossible to explain in detail without diagrams and sections. Exploratory work is being conducted at present in a considerable number of places throughout the Cariboo district thought to be suitable for hydraulic mining. Further attempts, with better appliances than before, are also being made to "bottom" some parts of the continuation of the well known auriferous channels of the central and mountainous portion of the district.

"Mr. C. F. Law has kindly supplied some details of the work being done on the deep ground in the Willow River valley, in which he is interested. This is the main continuation of the valley of the famous Williams Creek. Near the mouths of Mosquito Creek and Red Gulch, four prospect holes have been bored to bed-rock through the alluvial materials filling the Willow River valley. The bed rock was reached at a depth of from 67 to 109 feet. The old channel was discovered at the depth last mentioned, at a distance of about 500 feet to the southward of the present river, and was found to be capped by a hard ferruginous cement, beneath which is four feet of pay gravel, which from the samples brought to the surface appears to be very rich. Some good payable gravels were also encountered in the side ground, and a shaft, with adequate pumping and other machinery, is now being sunk on the deposit.

"Work of a similar character to the above is also I understand being carried on by the Slough Creek Mining Company, in the valley so named, in which the old channel upon bed rock is reported to have been reached by boring at a depth of 245 feet.

"In an article in *The Province* (Victoria, B.C., Nov. 10, 1894), Mr. Law directs special attention to a gravel deposit on the west side of the Fraser, opposite the mouth of the Quesnel river, which he proposes further to investigate. The deposit is capped by basalt, and Mr. Law very properly draws attention to the probability of its extension, and the existence of others like it in the great basaltic area to the west of the Fraser,* quoting Mr. Hobson's opinion to the effect that the Quesnel river system at a former period (before the excavation of the Fraser Valley), flowed westward to the coast. The gravel deposit here particularly referred to, was first noted by Dr. Selwyn in 1875, and a section showing its relations, based on measurements by Mr. Webster, is given in my report for 1875-76 (pp. 257, 263), according to which the base of the basalt capping is about 700 feet above the Fraser or approximately 2,380 feet above sea level. Mr. Law has already ascertained that these gravels contain at least some gold, and from the appearance of the exposures he believes them to represent an old river channel. Should this prove to be the case, it does not, however, follow that the old river flowed westward, it is perhaps even more probable that the general direction of the drainage in this region, was northward, during a considerable portion of the Tertiary period, as I have elsewhere suggested. Attention may further be directed, in this connection, to the notes given in my report already referred to (pp. 263-64), on very similar gravels met with on the lower part of the Blackwater river and elsewhere along the Fraser Valley. Some of these closely resemble the more lately discovered auriferous gravels of the Horsefly, and may be of the same age, although it would not necessarily follow from this, that all are equally auriferous, this being likely to depend on the local source of the gravels in each case.

"Many of the general questions relating to the conditions governing the occurrence of auriferous placer deposits in the Cariboo district as a whole, so far as these are already known, require treatment in greater detail than can here be accorded. It must suffice at the moment, to point out that the late developments have already resulted in greatly extending the area of prospecting and prospective mining, in the manner previously suggested by me on more than one occasion.† The central portion of the Cariboo district,—that in which the highly concentrated auriferous deposits of Williams, Lightning and other well known creeks have been worked—may be described as a mountainous region, surrounded by lower hills and lowlands to the south, west and north. In this mountainous tract, the valleys of streams are deeply cut, and the modern streams still occupy the lines of a very ancient erosion. In surrounding regions the lower portions of the same streams have evidently, at different periods, flowed in many different courses. both before and after the date of the great basalt eruptions; being there subject to changes induced by comparatively slight alterations in relative level of different parts of the country, as well as to many other causes. Where the older channels thus formed, or the gravelly deposits discharged by them on wider areas, antedate the basalt flows, it is now as a rule difficult to find any superficial indications of their existence; but in the case of later streams, and in places to which the basalts have not extended, many of the old valleys may still be found and followed without difficulty. The superficial filling of such valleys, together with the latest changes in the courses of streams, have resulted chiefly from the deposits and effects of the ice of the glacial period, and the study of all the conditions and events of that period has, in British Columbia, a most direct connection and importance in relation to the questions of mining. Allusion has been made to some of these effects in previous reports, but much yet remains to be ascertained and applied, for the problem is essentially a new one in regard to placer mining, no such conditions of a general kind being met with in California, Australia, or any other country in which alluvial gold mining has been extensively prosecuted.

"'The Shuswap series occupies the basin of the Kootanie Lake, from Kaslo south, for at least forty miles. It borders both shores of the lake, in bands varying in width from one to two miles or more. The strike, north of Balfour, is nearly north-and-south, but south of the

*See geological map of a portion of British Columbia between the Fraser river and the coast range. Report of progress, Geological Survey, 1875-76.

† Mineral Wealth of British Columbia. Annual Report of the Geological Survey. Vol. III. (N.S.), p. 45R *et seq.*

EN PASSANT.

The Annual General Meeting of the members of the Asbestos Club was held in the Club House, Black Lake, Que., on Tuesday evening, 25th instant. A full report will be found elsewhere.

We regret to have to chronicle this month the demise of Mr. W. H. Jeffrey, for many years identified with the Canadian asbestos industry, and, until recently, the owner of the well known Jeffrey mine at Danville. Mr. Jeffrey had attained the ripe age of eighty-five and succumbed to a brief illness on Easter morning, at his residence, Newhurst Grange, Richmond, Que. The REVIEW extends its sympathies to Mr. Harry Jeffrey and the other members of the family in their bereavement.

The total output of coal from the British Columbia collieries for the year ended 31st December last amounted to 1,012,983 tons, while 827,640 tons were exported.

The exports of coal from Nanaimo for March are somewhat in excess of February, being as follows :—

Wellington colliery	20,377 tons.
Union colliery	25,066 "
Nanaimo colliery	24,144 "

Mr. John Hardman, M. E., S. B., Halifax, Past President of the Mining Society of Nova Scotia, was married in Ottawa, on 23rd instant, to Miss Lizzie McCarthy, daughter of Mr. Henry McCarthy. Needless to say congratulations are in order.

The value of the imports of mining machinery admitted into the Dominion free of duty during the fiscal year ended 30th June, 1894, was $87,035, of which $2,285 was imported from Great Britain, and $84,750 came from the United States. By Provinces the distribution was as follows :—

Ontario	$39,198
Quebec	13,683
Nova Scotia	26,610
New Brunswick	940
Manitoba	1,322
British Columbia	5,282
Total free of duty	$87,035

Important practical tests of wire rope and fastenings for it have lately been made at the railroad shops in Scranton, by the Deleware, Lackawanna and Western management. The published account shows that 1½ inch steel cables are used in some of their mines, and these tests were made to determine whether or not the fastenings were as strong as the cables. Sockets with taper holes, known as rope cones, to receive the rope, and ending in a fork to fasten the cage, were used, the rope being passed through the hole and the ends of the wires turned back, making a bushy head. Into this mass of twisted and doubled wire, lead or Babbit metal was poured, and the pieces were tested in their regular wheel press. It was soon proved that the rope was amply strong, sustaining seventy tons with no other effect than a reduction of diameter, owing to the compression of the soft centre; lead proved very soft for fastening the wires, they pulling through it, but a composition of three parts lead to one part antimony did far better. The forks sustained load enough to bend steel pins two inches in diameter before breaking, but, when the latter took place a curious fact was exhibited, viz., one side of the fork breaking in two pieces, and one piece about an inch long dropping to the floor, this happening when the load was about seventy tons, but the cross section of the metal was the same where each break occurred.

The Ontario Government has, through the Hon. A. S. Hardy, Commissioner of Crown Lands, voted an annual grant of $300 towards the work of the Ontario Mining Institute We are also pleased to learn that a sum of $500 has been placed to the credit of the Mining Society of Nova Scotia, by the liberality of the Government of that Province. These are substantial and encouraging evidences of recognition of the efforts being made by these organizations to foster and stimulate the mineral development of the country. By and by we hope to record that the oldest and strongest organization of them all, the General Mining Association of the Province of Quebec, has not been forgotten at the ancient capital. The Quebec Government cannot spend $1,000 to greater advantage to the country than by appropriating this amount for the educational work of the Association.

Ahout a dozen students of the McGill Mining School left Montreal on 22nd to spend some time as the guests of President Blue, at the Eustis Mines, Capelton.

A serious shock has been imparted to the confidence of investors in West Australian gold mines by the exposé of the Londonderry fraud. People who rushed to subscribe to the capital of £700,000 on the strength, firstly, of the phenomenally rich specimens which were exhibited in a shop window in the heart of the city of London, and, secondly, on the glowing statements made in the prospectus, and people who subsequently bought the shares at 50 and 60 per cent. premium, on the strength of the statements that were made at the statutory meeting held in January last—statements that read like a fairy tale—will naturally rub their eyes and ask if they are dreaming; if, in fact, it can be true that all the golden wealth that was flourished before their dazzled eyes was a mere phantom of the imagination. At the meeting the chairman said he had been told by Mr. Shaw, the mayor of Coolgardie, that "in eight weeks he could take out five tons of gold." He (the chairman) then went on to say: "The place is sealed up. The gold there is somewhat the same as going into a bank and taking out the sovereigns, and we must be very cautious. * * * The whole is cemented over, sealed and built over with iron, because the place is so rich." A gentleman present at the meeting said that he saw the property before Lord Fingall bought it, had seen the phenomenal specimens which were taken out of the mine, and averred that the stone "which remained after they had been extracted was equally rich." Lord Fingall, in his address said, on the authority of local experts, that the "rich shoot in the principal mine went about 6,000 ounces to the ton, and at seventy feet it went about 600 ounces to the ton;" that "experts there had made a calculation that every twenty feet of quartz similar to what was at the surface should be worth from £300,000 to £400,000." So this marvellous tale went on, and now that the capital has been subscribed and the mine unsealed, the whole thing vanishes into thin air!

Mr. William Garrett, says the Pittsburg Dispatch, made recently the statement that wire nails are now sold so cheaply that if a carpenter drops a nail it is cheaper to let it lie than to stop and pick it up, and it is claimed that one keg out of five is never used, but goes to waste. A statistician figuring this out and assuming that it takes a carpenter 10 seconds to pick up a nail, and that his time is worth 30 cents an hour, remarks that the recovery of the nail he has dropped would cost 0.083 cent. The money value of an individual sixpenny nail is 0.0077; that is, it would not pay to pick up 10 nails if it took 10 seconds of time worth 30 cents an hour. Ordinary men who are not very quick can, however, pick up a nail on a moderately clean floor in five seconds. Assuming that this is a better average than the 10 seconds, and that we are paying the carpenter only 25 cents an hour, it will still cost to recover the nail .0347 cent, which is nearly five times the value of an individual nail. There is, therefore, a considerable factor of safety in the original calculation, and we are bound to believe that it will not pay to pick up nails. Such a calculation brings out clearly the marvellous reduction in prices due to inventive genius. The lurking fallacy is that while it may not pay to stoop for each nail, it still may be worth while for an economical man at the end of his work to stoop once and sweep up in a single handful the nails he has been dropping all day.

As mining in Kootenay reaches a basis of practical work, and the product of the mines goes out into the markets of the world in competition with that from other districts, the need of facilities of different kinds that will lessen the cost of production forces itself to the notice of the miners. Great strides have been made in the matter of transportation, and the matter of fuel is now forcing itself up for attention. Speaking on that point a gentleman recently from the district said: "Kootenay, and even that district west of the Columbia river, want cheaper coal and coke. It is to be had almost at their door in Crow's Nest Pass, but without a railway it might be anywhere else on earth. The C. P. R. and British Columbia Southern have charters to build the line, and the people of Kootenay are wondering now what they are going to do. As an illustration let me point out the situation which confronts the Pilot Bay smelter. The management is importing coke from Washington at a cost of $13.77 per ton, and I believe the first cost is $5 and the freight $8.75. Now a reasonable charge for the same article shipped from Crow's Nest Pass would be $7, leaving a balance in its favor of $6.75 on every ton in comparison with the Washington article, It would perhaps be all right if the American tariff did not go so hard against the shipments of lead from the smelter. Between March 16th and 27th about 600,000 pounds of bullion was shipped to Aurora, Ill. It all went forward in bond to be refined, and for every ton of the lead sold in the United States $20 duty will have to be paid. It went in bond, and will all be returned to Canada, perhaps to Toronto and Montreal. Of course when the smelter has a refinery added it will be independent in the matter of trade conditions, but to compete with the added disadvantage of costly fuel is an unfavorable contest. Kootenay wants cheap fuel and must have it."

In view of the important developments now taking place in our chromic iron deposits in the Eastern Townships, the following from the Australian *Mining Standard* will be of interest: "Chrome mining is being carried on with some success in the Tumut-Adelong district of New South Wales. In the opinion of a Sydney expert, chrome may be found in any part of a serpentine belt 35 miles long by 1½ miles wide, but the bodies are too small to tempt capitalists to operate. Individuals may succeed, however, and the anticipation is that 300 men might earn £3 per week, the article being worth 70s. per ton in Sydney, of which freight, etc., absorbs about 20s. The output during 1894 was about 4,000 tons. According to the same authority, 'The mines have been worked dangerously by men who knew nothing about mining, and it is only a miracle that they were not killed. Even at the present time I would not take £10 an hour and sit in one of them. With one exception there is not a stick of timber in any of them.' The value of these chrome deposits have evidently been exaggerated in London, where it is reported that the assays go over 70 per cent., but on reliable local authority it is stated that the percentage does not exceed 60. In New Caledonia miners are again turning their attention to chrome, although export has never quite ceased from that island. 'The best chrome mine ever known,' says a contemporary, was called the Luck Hit. This, however, had a chequered career, and finally, after producing from 12,000 to 15,000 tons of ore, was closed down as being worked out. A large group of mines in the same district as the Lucky Hit was floated into a company in Sydney, but did not exist long, and the property was eventually sold by auction in Noumea, returning into the hands of the original native owners. The south end of the island has alway been the chrome district; hut deposits havs been worked in other parts though without much success. Years ago a very large deposit was discovered in the north end of the island, but up to the present it has not been worked, although it was laid before many good men in Noumea. There was some hesitation about takidg it up, as the ore was considered to be far too low a grade, and there were serious difficulties in the way of transport. Alluvial chrome mining has been carried on to some extent, but hitherto without success. However, this branch cannot be said to have been thoroughly tried, and undoubtedly large and workable deposits do exist."

The following comparison of the cost of hand labor as against rock drills in tunnel work in a neighboring colony has been furnished us: December 3rd to 8th, 11 shifts, driven 24 ft.; cost, 6 packets gelatine, £3 12s. 6d; 40lb. rackarock, £3 6s. 4d; 16 lb. candles, 8s. 8d; 20 coils fuse, 11s. 8d; oil, 2s. 6d; caps, 3s.; drillers, £5 10s.; helpers, £3 17s.; total £17 8s. 8d.

Previous to the drills being used the contractors were paying £1 10s. 6d. per foot to break the ground, and find their own explosives.

	£	s.	d.
24 ft. at £1 12s. 6d. = ...	39	0	0
Cost by rock drills as above	17	8	8
Saving in favor of machines.........	21	11	4

It is difficult to institute a fair comparison between the cost of hand labor and machine drilling in a short contract. No provision is made, for instance, for interest on the capital represented in the rock drill, nor is any allowance made for wear and tear and supplies. These additions, of course, would not by any means wipe out the wide margin of difference between the two costs, but in a long run they would form an appreciable item.

The newest scare comes from Paris. According to some of our French contemporaries, the Paris Faculty of Medicine have sent a communication to the post office authorities, setting forth the danger of spreading contagious diseases by the use of the telephone. This, it is added, can be prevented by applying to the mouthpiece of the instrument a specially prepared antiseptic paper. If the man of the future is going to spend his time in learning what he ought not to do for fear of the ubiquitous microbe, it is quite certain he will never do anything else. Unfortunately, the microbe appears to be everywhere and in everything, and we can only avoid it by abstaining from eating and drinking and breathing, which is a cheap and simple remedy, but fatally inconvenient.

The largest derrick in the world is said to be that used in the granite quarry of C. E. Tayntor & Co., at Barre, Vt., says *Stone*. Its mast is 89 ft. high, and is held by 10 guys, each running out about 200 ft. to heavy anchorages. The boom can swing around a circle 142 ft in diameter, and like the mast is built of Phœnix columns. The loads are hoisted by means of a steel wire rope 1¼ in. in diameter, and the boom itself is handled with a similar rope of ¾ of an inch diameter. Over a mile of steel rope was used in rigging the derrick, and its weight, exclusive of the rope, is about 50,000 lbs. It is operated by means of a hoisting engine, and so well are all parts designed that a pull of 300 lbs. at the end of the boom will revolve the whole appliance when the boom is horizontal and loaded with 37½ tons The yerrick has been tested with a load of 57½ tons, although designed to carry only 40 tons; and if the ropes were heavy enough, the remainder of the apparatus has sufficient strength to carry lhads of 80 tons. It replaces a derrick which had a mast and booms of very large sticks of pine. but the largest which could be procured were unable to raise with safety the heavy loads that had to be haddled occasionally in the quarry.

Of special interest to those who are concerned in colliery working are the conditions under which the Belgians manufacture coke from a rather inferior quality of coal, so as not only to be able to use it in their own blast furnaces, but to export considerable quantities in competition with the English coke industry. This is attributed in great part to the employment in Belgium of different kinds of ovens from those ordinarily employed in England, and more especially the Semet and Coppee ovens. In a semet oven it is stated that a ton of coke, which would cost over 18 fr. in the bee hive type, can be produced for rather over 15 fr., showing a sensible difference in favor of the Semet. In the Coppee oven the labor charges attending the production of a ton of coke are stated to be about 11d. as compared with 1s. 3d. in the ordinary bee hive system. The Appolt oven is also used in Belgium to a considerable extent, but it labors under the disadvantage of being more expensive in the matter of first cost than either of the other systems named, an experienced authority having given the average cost of installation at 5,000 fr. for the Appolt, 3,000 fr. for the Semet, and 2,500 for the Coppee. The production of coke in Belgium, has, however, made comparatively slow progress of late years. In 1873, the output was not more than 1,838,000 tons, and in 1892 it was only about 350,000 tons above that quantity. There are altogether about 2,600 coke ovens of all kinds, but a large number of them are generally unemployed, the cost of production being such that unless the realized price of coke rises above 12 fr. per ton, it does not pay to produce it. The average practice gives from 72 to 74 per cent. of the coal used in the form of coke.

CORRESPONDENCE.

Maps of the Nova Scotia Gold Fields.

To the Editor:

DEAR SIR,—On page 55 of your number for March I observe a paragraph referring to some very excellent maps that were made by Mr. W. Bell Dawson in 1881-82 eastward, *not west*, of Halifax, Nova Scotia, under "*the direction of Dr. Gilpin.*" It is to be hoped that this latter statement was made in error. So far as I am aware Dr. Gilpin had nothing to do with the work, either in its inception or in its direction.

It was commenced in 1881 under my direction, and in part paid for by the Geological Survey. I enclose you copies of two letters on the subject, addressed by me to the Hon. S. H. Holmes in 1881 and in 1882, which I would now ask you to publish as the readiest means of refuting the misstatement and making the truth known.

In view of my letter of 1882 it would be interesting to know why, and on whose advice, this admittedly valuable work was discontinued. In the records of the Depattment of Mines in Halifax a satisfactory reply might probably be found.

I am, dear Sir, yours truly,

ALFRED R. C. SELWYN.

Ottawa, 22nd April, 1895.

COPY LETTERS REFERRED TO.

GEOLOGICAL SURVEY OF CANADA,
OTTAWA, 28th Feb., 1882.

DEAR SIR,—I am now making arrangements for the work of the Geological corps during the coming season, and would be glad to know whether your Government is disposed to co-operate in carrying on the survey of the N. S. gold fields on the same terms as last year. The result of the work if continued will, I am confident, prove satisfactory, and be valuable not alone as an aid to the development of the mines but also in all undertakings where an accurate and reliable map is required.

I am, dear Sir, yours faithfully,

(Signed) ALFRED R. C. SELWYN.

The Hon. S. H. Holmes, &c., &c.,
Halifax, Nova Scotia.

GEOLOGICAL SURVEY OF CANADA,
OTTAWA, May 30th, 1881.

MY DEAR SIR,—I enclose with this copy of letter and estimate of cost for one year of the proposed survey of Nova Scotia gold fields which I received from Mr. W. Bell Dawson on Saturday, 28th inst.

If the terms mentioned meet your approval I would suggest that one half the sum named be paid by the Government of Nova Scotia and one half from the Geological Survey appropriation, and to facilitate payments and dealing with the accounts that you should authorize me to draw on you for the amount agreed on, whenever required, copies of all correspondence, vouchers, reports and other documents connected with the work to be furnished to your Government.

I am, dear Sir, yours faithfully,
(Signed) ALFRED R. C. SELWYN.

The Hon. S. Holmes, &c., &c.,
Halifax, N.S.

COMPANIES.

The Horsefly Hydraulic Mining Company.—The annual meeting of shareholders was held in Vancouver on 13th ulto. The report of the manager was read and considered to disclose a very satisfactory state of things. The report stated that 12 miles of the ditch (to bring water for hydraulic purposes) had been completed, the dimensions of the ditch being 8 feet at the top and 4 feet at the bottom, with a depth of 2 feet 8 inches. There is also 1½ miles of 30 inch rivetted steel pipe. The capacity of the ditch system is equal to 1,800 miner's inches of water, and the reservoir will have storage sufficient for a supply for 28 day's service. The two Giant motors will each deliver 900 miner's inches of water, with a 7 inch nozzle, at a pressure of 160 feet. Five dams have been constructed in connection with the ditch and reservoir system. Additional hydraulic plant will be placed in position during the ensuing season and the work of washing the gravel will be commenced at a second place. The company has erected its own sawmill to supply lumber for building sluices and other works. Already 26 buildings have been erected on the property. The company has acquired 320 acres of farming land for the purpose of providing hay and pasture for its live stock, which at present consists of 21 horses and mules ; 13 of these are pack animals, which it has been found expedient to purchase on account of the difficulty of hiring transportation facilities when the forwarding of goods to the mine was a matter of urgent necessity. During the three short runs which were made gold was recovered to the value of $14,000. The total expenditure on the property, including plant, equipment, etc., exceeds $170,000.

Messrs. J. M. Browning, H. Abbott and W. F. Salsbury were elected directors of the company for the ensuing year.

The Cariboo Hydraulic Mining Co., Ltd.—Annual meeting of shareholders held at Vancouver on 13th ult. The report showed that 8 miles of the ditch have been completed and it is expected that 9 miles more will be constructed during the next three months. When completed the ditch will have a capacity of over 3,000 miner's inches of water. The hydraulic plant consists of about 2,000 feet of piping, varying from 18 to 22 inches ; two hydraulic " Giant " monitors, with 7-inch nozzles, which will have a hydraulic pressure equal to 300 feet.

As many as 250 men have been employed at one time on the company's works. It is expected that the 9 miles of ditch referred to above, will be completed before the supply furnished by the present ditch is exhausted. Additional hydraulic plant will be placed on the ground this spring and there will then be a supply of water ample for the continuous prosecution of operations.

As soon as the company can conveniently do so, it is its intention to construct a ditch from Morehead and Bootjack lakes. When this is done there will be a permanent supply of water even in the event of an unusually dry season.

A run was made on June 16th last, with 1,500 inches of water for a period of 127 hours, during a considerable portion of which time a good deal of the work was directed to clearing away boulders, etc. The result of the run was 302 ounces of gold, valued at $5,160, which is considered to be a very satisfactory yield. The results secured give ample proof of the richness of the gravel. Had it not been for the excessively hot and dry season, which caused the water supply to fail unusually early, the company would have made an excellent financial showing, even at this early stage of its existence.

The Montreal Hydraulic Gold Mining Co. of Cariboo, Ltd., has been incorporated to acquire from the Montreal and British Columbia Prospecting and Promoting Company, Ltd., certain placer mining leasehold properties and mining claims in the district of Cariboo, and to issue to the said company in payment therefor fully paid up stock of this company to an amount to be agreed upon between the Trustees of the two companies, and to operate the said properties and claims and any other properties and claims adjoining or adjacent to the properties of the company. The authorized capital is $250,000, in shares of $1.00. Head office, Vancouver, B.C. Directors—P. A. Peterson and John Kennedy, Montreal ; F. C. Innes, J. M. Browning, and S. O. Richards, of Vancouver.

The Cariboo Gold Fields, Ltd., has been registered under the Foreign Companies' Act, B.C., to adopt and carry into effect an agreement dated the 21st Nov., 1894, and made between the Whittier Gold Concessions, Ltd., of the one part, and W. W. Ellwood on behalf of the company, to acquire and work mining rights, etc., in the Province of British Columbia. Authorized capital £100,000 in shares of £1.

Nova Scotia Coal Mining Co., Ltd., is applying for charter of incorporation. Authorized capital $50,000 in shares of $50.00. Directors : C. F. W. Bell, E. Laurence, W. Macdonald, of Truro, N.S.; A. McKay, Kingston ; A. H. Learment, Truro; J. L. Stevens, Kingston - L. B. Crowe and A. C. McKenzie, of Truro. Formed to acquire and work coal areas in the Province.

War Eagle Gold Mining Co., Ltd.—Registered at Victoria, B.C., 18th Feb., 1895. Head office, Spokane, Wash. Authorized capital, $500,000 Formed to operate, bond, buy, sell, lease, locate and deal in mines, metals, and mineral properties in the Province of British Columbia.

The Wiegand Gold Mining Co. has been incorporated for the purpose of developing the property on Shoal Lake, near Fort William, Ont. One shaft is already down 14 feet and is under contract to be sunk 100 feet. A stamp mill is expected to be in operation about the middle of next month, with a capacity of 30 tons per day. The officers of the company are : President, Joseph C. Foley ; vice-president, V. D. Cliff; secretary, J. J. McAuliffe.

The Vermillion Mining Co. of Ontario.—The annual general meeting of shareholders will be held at office of the Canadian Copper Company, Sudbury, on Wednesday, 15th proximo.

The Providence Gold Mining Co. of Norland, Ltd., has been incorporated in Ontario to carry on operations in the County of Victoria, at the Village of Norland. Authorized capital, $40,000. Directors—Chesley Tomlinson, George Arnold and Thomas Rye, all of East Gwillinbury, in the County of York, Ont.

Kootenay Mining and Smelting Company, Ltd.—This company has at present about 140 persons employed in the construction of its smelter plant at Pilot Bay, B.C. The works are situated on a peninsula nearly in the center of the east shore of the lake. They consist of three main buildings : the smelter, the concentrator, and a building which contains the roasting furnaces. These buildings partially enclose a yard in which are situated the bins containing the ores, lime, coke, charcoal, etc. These materials are hauled from the barges, which bring them to the works, up an inclined plane to the top of the concentrator building. From that point they can be carried to any part of the works or to the bins in the yard, as may be required. There is also an elevator by which the concentrates or other material can be raised to any level that is desired. Besides these buildings there are smith's and carpenter's shops ; an assay office and a business office. In the concentrator building are two 9 by 15 Blake crushers, four 4-compartment arch jigs, two double column jigs, two double-deck Buddle tables and two Frue Vanners. The capacity of the concentrator is about two hundred tons per day. In the roasting house are four reverberatory furnaces, each 65 by 17 feet, with a capacity of 12 tons each per day. It is probable a mechanical furnace may be added which would practically double the capacity. The smelter at present consists of only one stack. The arrangements, however, will allow for the erection of two more stacks, and there is no doubt, that if the supply of ore will allow of this addition, the enlargement of the works would put the enterprise on a still better footing for successful financial operation. The smelter at present can treat 100 tons of ore, with the requisite complement of lime, charcoal and coke, which amount to about 40 tons more. In the first week of operation the output of base bullion averaged about 20 tons a day. Of course the quantity will vary according to the character of the ore treated. The power to operate the concentrators is supplied by a 150 h.p. Corliss engine ; an 85 h. p. Rider engine works the blowers, while a 30 h.p. high speed engine drives the dynamo which supplies the electric light with which all the buildings are fitted. The ore which is at present being smelted comes from the Blue Bell mine, about eight miles up the lake from the smelter, and the No. 1 mine at Ainsworth. The bulk of the ore from the Blue Bell mine is first concentrated and the concentrates roasted. No other flux but lime rock is required, as the ore carries a large percentage of iron. The Blue Bell mine is the oldest discovery in the district. Years before there was any thought of mining in that district, it is said that the trappers connected with the Hudson's Bay Company dug out lead there and made bullets for their guns in a rude furnace, the remains of which are to be seen to-day. The developments at the mine consist of a tunnel only a few yards from the water's edge, about 1,200 feet long, and which gives access to the various slopes, crosscuts, uprises, etc. Besides this an open cut has been made at the top of the hill, immediately above the underground workings. This cut has laid bare large deposits of carbonates many feet in width, which turn into galena as they descend. The ore as won from the cut is shot down a shaft into the tunnel and thence carried to the wharf for shipment. The magnitude of the output may be judged from the fact that in January and February it amounted to between 5,800 and 6,000 tons. The ore vein has been traced through the Blue Bell and other claims belonging to the Company for a distance of 5,700 feet. Throughout it can be worked economically as regards shipment, as the vein runs almost parallel with the shore. In the driving of the tunnel a seam of copper ore was discovered which gives from 11 to 26 per cent. of copper. The vein is said to be 6 ft. 10 in. in width and it is probable that the Company will add to the smelter special plant to treat this and other copper ores of the district.

Van Winkle Consolidated Hydraulic Mining Co., Ltd.—In his report, referred to elsewhere, Dr. Dawson describes the operations on this company's property in the Yale district, as follows :—

The original Van Winkle Flat, well known in former years as rich placer ground, consisted of the lower river-terraces, from a height of about 100 feet above the river, down nearly to the river level ; while river-bars, bare only at low water, were also worked with profit. The work was confined to the upper layers of these terraces and flats, and is reported to have averaged at the rate of about $6 a day to the hand.

The object of the present owners is to work by the hydraulic method, the whole mass of the higher terraces or " benches " which rise from the river in successive steps, towards the base of the mountains on the west. The first principal bench has a height of about 100 feet above the mean high water of the Fraser, the next is about 60 feet higher, and there are others at still greater heights.

The water employed is obtained from the south branch of Stein Creek, and being chiefly derived from the melting snow of the higher mountains, it cannot be depended upon after the weather becomes cold in the autumn. An ample and constant supply might, however, be obtained by extending the ditch to the main stream of Stein Creek. The water is delivered at the sand-box at a height of 377 feet above mean high-water of the Fraser, giving a head of more than 300 feet at the work. The pipe-line from the sand-box is about 1,500 feet long, with a diameter of eighteen inches, and about 1,600 miner's inches of water is employed. A large amount of gravel has already been excavated, the pit taking the form of an isosceles triangle, of which the apex touches the river, the base being at a distance of about 1,200 feet. The ground has not proved so rich as was anticipated, but the working face is now being carried back into the second bench, in which the gravels, wherever prospected, appear to be more highly auriferous.

It is difficult to explain the geological relations of the gravels exposed in this work, without entering into the general question of the deposits of the Fraser valley in greater detail than is here possible. The history of these deposits is traced in the report on the Kamloops sheet, now ready for publication ; but as this is the first attempt on a large scale to work the higher benches of the Fraser valley, the main facts may be alluded to. All the gravels here exposed are believed to be later glacial or post-glacial in age. No boulder-clay is seen, nor is any true bed-rock reached. The lowest deposit cut through, consists of well rolled gravels, sometimes bouldery, with a sandy matrix, which pass largely, at a distance from the river-bank, into coarse irregularly stratified sands and fine gravels, occasionally lightly cemented. This deposit appears to represent what now remains of that filling of the valley due to a period subsequent to that of the removal of the boulder-clay by river erosion. It is comparatively poor in gold. When the conditions permitting such accumulation changed, and the river again began to cut down through the deposits above mentioned, it flowed from time to time over different parts of the whole width of the valley, producing the existing series of terraces and benches in the course of its irregular excavation, and leaving portions of its bed at different heights, filled with more recent river gravels. These consist in part of the rearranged material of the lower deposit, in part of materials brought by the river from places up stream. In these old river gravels the greater part of the gold, found at this place, occurs. It is to be noted, that wherever the lateral streams in the immediate vicinity cut through gold-bearing rocks, the lower deposit first described, may be expected to contain a considerable proportion of gold. This should be the case for instance in the vicinlty of Lillooet. Of the old river-channels themselves, the higher must in all cases be the older, the lowest and latest being represented by the gravel deposits of the flats nearest to the present stream.

In the Van Winkle pit, the stratified auriferous gravels forming the upper part of the lower, or 100-foot bench, are probably newer than those of the next bench above, which is now being worked into; but this cannot be actually determined till the lowest part of the channel filled by the last named gravel is exposed, and its height compared with that of the 100-foot bench. The older auriferous gravels due to a still earlier period of river erosion, which may be assumed to exist on the bed-rock proper, or whatever may remain of the boulder-clay, must now be altogether beneath the level of the present river.

In the vicinity of Lytton, two companies are also at work experimenting with barges and sand pumps or equivalent apparatus, with the object of working the auriferous gravels of the present river-bed, but no details are available in respect to the result of these operations. Renewed interest is also being taken in the gravel deposits near Lillooet and elsewhere, and there is now every prospect that all such deposits along the Fraser River will be thoroughly examined and, where found satisfactory, worked.

Remarks on Wire Ropes.*

The writer does not intend, in this paper, to deal with the history of the manufacture of wire ropes, as he believes that ground has been already covered by other papers, and it would probably serve no useful purpose to repeat it here; he therefore intends confining himself to giving a few general remarks on ropes, &c, for the consideration of mining students, and particularly to draw their attention to improvements obtained by the Westgarth patent ropes.

It is undoubtedly the first essential property of a good rope, that the steel of which it is made, should be of the most uniform nature; secondly, that the wires should be laid or twisted to form the rope on the most scientific principles.

In the early days of wire rope manufacture, ropes were made either of charcoal or mild steel, having a breaking strain of about 35 and 45 tons per square inch respectively. More recently a "Patent Crucible Steel" having a breaking strain of from 75 to 90 tons per square inch has been largely adopted, but this in turn has been almost entirely superseded by a "Patent Improved" or basic steel, which also has a breaking strain of from 75 to 90 tons per square inch. This material has no doubt been adopted in consequence of its heing so much cheaper than the crucible steel. At the present time there seems to be a tendency on the part of users to adopt more generally ropes made of "Plough Steel" (which probably derives its name from the fact that steam ploughing ropes were made of this material), which has a breaking strain of from 100 to 120 tons per square inch. Whether this is in consequence of the patent improved or basic steel not giving results equal to the results of the patent crucible, or the fruits of the very keen trade competition which has led to a considerable reduction in the price of the plough steel quality, is a very debatable point. Probahly where haulage systems have been extended to a considerable extent, circumstances have demanded the lightest class of rope with the highest tensile capacity; for such positions plough steel has been found most useful.

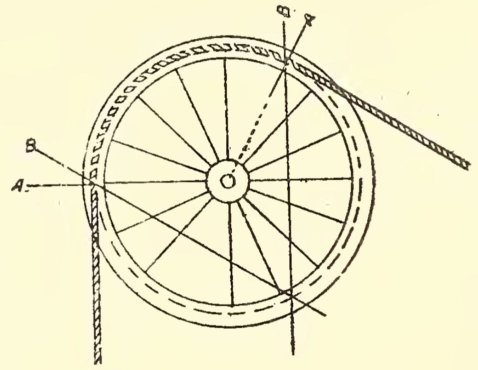
The relative values of ropes of various sizes made of the afore-named qualities, as far as the breaking strain is concerned, may be seen in the following table:—

ROUND WIRE ROPES.

Bessemer Steel, B. S. 45 tons per square inch.	Patent Crucible or Patent Improved.	Extra Plough Steel.	Equivalent Strength in Tons.
1⅛ in. circ.	....	....	2
1¼ "	1 in. circ.	....	3
1½ "	1⅛ "	....	4
1⅝ "	....	....	4½
1¾ "	1¼ "	1 in. circ.	5½
1⅞ "	1½ "	1¼ "	6
2 "	1⅝ "	1⅜ "	7
2⅛ "	1¾ "	1½ "	8
2¼ "	1⅞ "	....	9
2⅜ "	....	1⅝ "	10
2½ "	2 "	1¾ "	11
2⅝ "	....	....	12
2¾ "	2⅛ "	1⅞ "	13
2⅞ "	....	....	14
3 "	2¼ "	2 "	16
3⅛ "	....	....	17
3¼ "	2⅜ "	....	18
3⅜ "	2½ "	2⅛ "	20
3½ "	2⅝ "	2¼ "	22
3⅝ "	2¾ "	....	23
3¾ "	3 "	2½ "	25
4 "	3¼ "	2⅝ "	28
4¼ "	3⅜ "	2⅞ "	32
4½ "	3⅝ "	3 "	35
4¾ "	3¾ "	3⅛ "	40
4⅞ "	....	3¼ "	44
5 "	4 "	3⅜ "	48
5½ "	4¼ "	3½ "	53
6 "	4¾ "	4 "	67

*Paper before the British Society of Mining Students.

From the student's standpoint, the difficulty no doubt is to ascertain the breaking strain or power of a rope without reference to the various trade tables. It is only necessary however to ascertain the number and sectional area of the component wires and the breaking strain per square inch of the steel of which they are made, and the difficulty of ascertaining the breaking strain of any given rope is overcome with a very ordinary calculation. But for all actual working purposes, it is most advisable to communicate with some good maker, giving all possible data.



If the breaking strain of any particular rope be desired, without going to the expense of having a proper test made, probably the best way would be to test to destruction a single wire by suspending a weight on it, the result, multiplied by the total number of wires (excluding the centre wires), less 5 per cent. for combination, would give roughly the actual breaking strain of the rope.

Another question which may arise in the mind of the student is, what is the most suitable class of rope for the various classes of work? Generally speaking, the patent crucible or patent improved is probably the best, but the answer in each particular case should be determined by the particular conditions under which the rope has to work. Where the drum and pulleys are very small, probably the milder qualities of steel will be found best, but where the drum and pulleys are large, the higher class plough steel may be used with economy, except in places where there is water.

As regards construction, as will be shewn further on in this paper, there are three distinct classes of work, each of which it is essential should be carefully considered. However, as regards the capacity or factor of safety for winding ropes, for pits over, say 400 yards deep, the breaking strain should be ten times the weight of the working load; under 400 yards, eight times that of the working load; and in haulage or transmission of power, about seven times that of the working load. On self-acting inclines the margin would be quite sufficient if the breaking strain were four times the weight of the working load. Although in general haulage it is very questionable economy to reduce the margin below one-seventh, as it is well-known that there are frequently accidents, which place the rope, with the engine at one end of it and the load a fixture at the other end of it, and in such cases it is generally the rope that has to suffer, even to breakage, through "plucking." It would therefore be very much better if the capacity of the rope were fixed in proper relationship to the developed power of the engine, which can be easily ascertained.

Probably one of the most important points with reference to winding ropes is the angle, both horizontal and vertical, at which the ropes have to work, as it is such circumstances or conditions that determine the amount of friction that will take place on the rope. It would therefore be undoubtedly interesting to the students if some of the members would supply, say the horizontal and vertical angles at which winding ropes are working at various pits, giving the size of rope, nett working load, daily output, and the life-time of the ropes, giving the size of drum and pulleys also. Probably it will be found that, vertically, 30 degrees for the top rope and 45 degrees for bottom rope; horizontally, (*i.e.*, the angle between the centre line of the drum and the centre line of the pulley) about 1 degree, are very convenient angles, and such that will insure a rope-life of at least two years, provided that there are no injurious circumstances to contend with in the shaft.

As to pulleys of suitable size for various sizes of ropes—for ropes composed of six strands of seven wires each, where the rope has not to bend at more than 90 degrees (excepting at the drum), a very common rule is, that the drum and pulleys should measure 1 ft. diameter per pound per fathom of rope, *i.e.*, for a rope weighing 5 lb. per fathom, the drum and sheaves should be, say 5 ft. in diameter. Of course it is

FIG. 2.

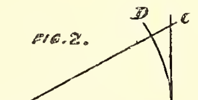


FIG. 3.

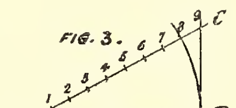
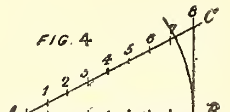


FIG. 4.



very difficult to lay down a hard and fast rule, as there are such various circumstances to be considered, both as to the quality of the steel and the angles round which ropes have to pass. In many main and tail haulage systems, where the engines are fixed on the surface, it is frequently the case that the ropes work over pulleys at the top and bottom of the pit shaft and round a return sheave, all of the same diameter, whereas there is a difference of 90 degrees betwixt the bend at the top and bottom of the shaft and the bend at the return sheave, and where the tail rope has the work to do, it is most essential that the return sheave should be as large as possible, as the amount of abrasion that takes place—when the return sheave is too small—is most injurious to any class of rope. It is therefore suggested that the foregoing rule may prove quite satisfactory for drums and pulleys at bends of 90 degrees for the plough steel quality of rope, and at bends more acute the sheaves should be correspondingly larger. For the milder qualities of steel ropes the sheaves may be proportionately smaller, provided the working load is also less, so that the higher the tensile capacity of the rope, the larger the pulleys or sheaves should be.

In the transmission of power by the endless rope system, after the question as to which is the best type of driving and driven sheaves has boen decided (here again it would be very interesting if those members who have had some experience with endless driving and driven sheaves would submit their testimony on this point), the most important and most delicate point is the tension or tightening arrangement. A very common error is made where the tension sheave is placed immediately after the rope has travelled over the pulley or sheave to which the power has to be transmitted. It is considerably more effective and does less injury to the rope if the tension or tightening arrangement is placed between the engine or driving pulley, some little distance in front of the pulley to which the rope is travelling and to which the power has to be transmitted, *i.e.*, the driven pulley. As it is obvious that the resistance or load is directly against the rope returning to the engine or driving pulley, it is therefore most essential that the rope after leaving the driven sheave should go as direct as possible to the driving pulley; when that is the case the tightening or "tension" is considerably less than in the other case.

In colliery work, the positions in which ropes work may be roughly divided into three distinct classes:—

1st—The overlap winding.
2nd—The underlap winding, and
3rd—General haulage.

Now, the object of the "Westgarth Patent" has been to manufacture such ropes that each wire shall traverse the rope in such a manner that the rope is particularly adapted to each of the above-named classes of work, which is accomplished by, 1st—manufacturing a rope in which each wire is "laid," so that it appears for friction for half a turn on the periphery of the rope on one side only, that is to say, the appearance of any given wire corresponds with itself in every successive twist of the rope in a regular and uniform manner. 2nd—By making a rope so that each wire is "laid" to appear on two opposite sides only, so that when any given wire is bearing on the trod of a pulley the abrasion or compression can only bend the wire directly in the direction of the plane in which the wire is laid through the rope, therefore the wires are never bent across their own axis, and the tension is thereby equalized over the whole sectional area of the rope. This may be more easily understood or appreciated by shewing the amount of expansion that takes place while a rope is passing over a pulley, for instance, where a 5 in. winding rope has to work over a 16 ft. diameter pulley, say for one-third of its circumference between the two squares, that is where the rope reaches the pulley and where it leaves it, there is a difference of 4½ in. between the length of the under and upper circles of the rope, as shewn by Fig. 1. The lines A and B cut each other on the under side or "trod" of the rope, and the divergence between

— Fig 5 —

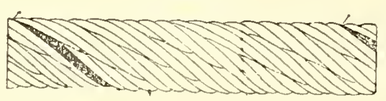
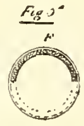


Fig 5A



— Fig 6 —

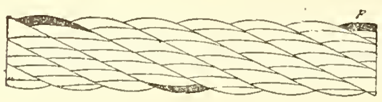


Fig 6A

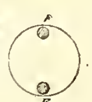


Fig 7

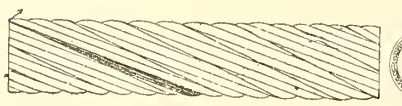


Fig 7A

them (in this case 4½ inches) where they intersect the top side of the rope, represents the amount of the expansion. 3rd—By making a rope in which each wire is "laid" so that it appears for fully one turn, (without contact across the rope's section, or ffriction. Of course the total frictional surface of a wire in any rope depends on the length and circumference of the rope, but it may be distributed in a variety of ways by different regulations of the twisting, and it is now generally admitted that the greater the length of wire exposed for friction on the periphery of the rope, the less rapid is the process of "crystallization" or decomposition of the steel. This has been fairly proved by a rope 1,700 yds., ¾ in. diameter, having worked out to a cost of ·16d. (decimal sixteen of a penny per ton) against the best previous record of. 18d. per ton on the same position, and by another working out to a cost of ·243d. per ton, against an average cost of. 350d. per ton for the three previous ropes worked under the same conditions. Each of the afore-named types of rope are protected by the Westgarth Patent, dated February, 1887, No. 2701.

Previous to this invention, a number of wires, generally seven, were twisted together to form a "strand," and a number of such strands, generally six, were twisted together to form a rope. The proportion of twist, with few exceptions, being two twists, forming the wires into strands to one twist forming the rope. But this and all other proportions were made without any consideration being given to what is known in the trade as "uptake," beyond allowing a sufficient or necessary length of strand to make a given length of rope, and the result was that the spirals or twists forming the strands were neither coincident nor uniform with the spirals or twists which formed the rope, consequently in every twist or lay of the rope each wire varied in its appearance from any definite line on the rope's periphery. It will therefore be understood that the principle underlying the Westgarth Patent is based entirely upon the fact of the "uptake" which is explained further by diagrams, Figs. 2, 3, and 4:

Fig. 2—Let A B represent a length of rope to be made, and A C the length of each strand required to make the length of rope A B, the arc or circular line D B shews that A B (rope) and A D (strand are equal in length, therefore the portion of strand D C is the extra length of strand absorbed by the twist, or in other words is called "uptake."

Fig. 3—Let A B and A C again represent rope and strand respectively as in Fig. 2. Further, let the several figures represent so many twists. It will be seen that the twists in the strand and the twists in rope are the same length, but on account of the greater length of the strand, there are nine twists in the strand A C and only eight in the rope A B. Consequently, although the length of twist may be the same in the strand and rope on account of the "uptake" in all stranded ropes, there has been, with few exceptions, a greater number of twists put into the strands than in the rope. It is also obvious from this diagram, that in this instance nine twists in the strand would be afterwards laid or twisted into eight. Thus every wire has had a torsional strain put on to it in the course of the manufacture of the rope, as is evident from the figures 1-8 and 1-9 in the rope and strand respectively. The positions of the twists do not correspond with each other, and accordingly the individual wires have varied in their positions in the exterior of the rope.

Again let A B and A C, Fig. 4, represent rope and strand respectively, and the figures so many individual twists. In this instance it will be seen that the number of twists in the strand and rope is the same, notwithstanding the greater length of the strand. It will also be seen that the ninth twist, shewn in the strand, Fig. 3, has been distributed over the preceding eight twists, and it is this distribution which the inventor calls an allowance to the twists in the strand of a percentage equivalent to the "uptake," and it is this principle that enables him to produce the three types of rope illustrated by Figs. 5, 5A, 6, 6A, and 7, 7A, Plate VII.

Figs. 5, 6 and 7, Plate VII. give a longitudinal section with *one* wire shaded to shew the uniform and regular manner in which each wire appears for friction on the periphery of the rope, as marked at F.

Figs. 5A, 6A and 7A, are end sctions to shew as far as possible what is intended to be understood by the terms "one side," "two opposite sides," and "for fully one turn."

Each of the longitudinal sections represents one twist or lay of rope, and every succeeding twist is a repetition of the same.

Mining in Ontario, 1894.

Mr. A. Blue, Director of Mines for the Province of Ontario, is to be congratulated on the promptitude of his issue of the summary report of the mineral production of the Province. The figures, dated 22nd March, are as follows:—

SALE AND LEASE OF MINING LANDS, 1894.

Districts.	No. of Patents.	Acres.	$
Rainy River	29	1,703	3,928 00
Thunder Bay	4	909	1,817 00
Algoma	5	551	1,740 00
Elsewhere	2	108	161 00
Totals	40	3,271	7,646 00

Districts.	No. of Leases.	Acres.	$
Rainy River	48	5,268¾	5,268 75
Algoma	4	298¾	278 75
Nipissing	9	360	285 38
Elsewhere	5	1,123	655 90
Totals	66	7,050½	6,488 78

Received for mining lands sold in 1894	$7,646 00
Received for mining lands leased in 1894	6,488 78
Received rentals in 1894 on mining lands leased in 1891, 1892 and 1893	3,807 78
Total revenue from mining lands	$17,942 56

MINERAL PRODUCTION OF ONTARIO, 1894.

Product.	Quantity.	Value.	Employés.	Wages.
		$		$
Dimension stone........cub. feet	1,340,000	360,470	854	336,700
Heads and sills "	47,070	15,900		
Coursing stone......square yards	22,000	36,000		
Rubble, etc..........cubic yards	223,000	142,000		
Sand and gravel .... "	733,500	203,450	175	61,650
Natural rock cement.....barrels	55,323	48,774	63	13,020
Portland cement "	30,580	61,060	105	31,858
Lime..................bushels	2,150,000	280,000	575	108,000
Drain title ....number	25,000,000	280,000	2,375	388,000
Common brick "	131,500,000	690,000		
Pressed brick, plain "	22,460,000	198,510	209	95,400
Pressed brick, fancy "	2,896,000	34,160		
Roofing title "	100,000	1,200		
Terra cotta	....	52,360		
Sewer pipe	....	207,000	56	23,000
Pottery	....	134,000	160	47,000
Gypsum.........tons (2,000 lb.)	3,253	9,760	36	9,500
Calcined plaster, etc. "	1,442	22,697		
Salt "	35,215	115,551	135	43,350
Nickel "	2,570½	612,724	655	311,719
Copper "	2,748	195,750		
Cobalt "	3¼	3,500		
Gold...oz.	2,022½	32,776	92	38,032
Petroleum ......imperial gallons	34,912,360	....	....	....
Illuminating oil "	14,349,472	1,337,040	486	279,930
Lubricating oil. "	3,817,181	242,688		
All other oils "	10,632,141	343,416		
Paraffin wax.......lb.	2,754,300	152,467		
Fuel product	....	71,326		
Natural gas........M cubic feet	1,653,500	204,179	99	53,130
Totals 1894	....	6,088,758	6,075	1,840,289
Totals 1893	....	6,120,753	7,162	1,935,590

ASBESTOS CLUB.

Annual Meeting of Members.—Election of Officers and Papers Read.—A Successful Year.

The sixth Annual General Meeting of the members of the Asbestos Club was held in the Club House, Black Lake, on 25th instant. The reports of council for the year were adopted, the finances being declared in an excellent condition. Five new members were elected. The ballots on being opened and counted, the following were elected office-bearers for the year 1895-96 :—

President :

Capt. Prideaux.

Vice-Presidents :

L. A. Klein, M.E. and Dr. J. A. Marcotte.

Secretary Treasurer :

Mr. R. Stather.

Assistant Secretary :

Mr. T. H. Crabtree.

Council :

Capt. Penhale, T. A. Poston, George R. Smith, Dr. C. E. Morin, H. J. Williams, W. J. Smythe, John Falls.

A vote of thanks to the retiring officers terminated the proceedings of the afternoon session.

The members and their friends reassembled at 7.30 p.m., the president in the chair. The first paper for consideration was that on

Characteristics of Explosives.

By William Glenn, of "Baltimore Chrome Works," Baltimore, Md.

Having a perfect right to define a word as may best suit our particular uses, and the special objects we have in view, we may define an "explosive" as being a body which when ignited, or when violently shocked, bursts with great energy, or decomposes with great violence. I propose to speak of gunpowder and of nitroglycerine, the two explosives now most in common use ; especially because they happen to be typical of two classes of explosives and of two methods of exploding them.

Gunpowder is a mechanical mixture which when ignited burns explosively ; burns almost precisely as does wood in the stove or oil in the lamp, only its combustion is exceedingly rapid and therefore its total energy is liberated in a brief period of time. Before we can understand what combustion is, and why gunpowder burns with such rapidity, we must first make a short study in combustion.

In the latter part of the last century, Priestly separated from mercury oxide a gas which afterwards became to be known as oxygen. Subsequenty, other workers found this body in ordinary nitre, in iron rust, and indeed in almost all other forms of matter. It exists largely, and in the free state, in the earth's atmosphere. Lavoisier took up Priestly's work and was the first to announce that the burning of wood, of oil, and of all other bodies which burn in air, is due to oxidation alone. For example, he maintained that when wood on the hearth is heated to the kindling temperature, it begins to combine with the oxigen of the air ; and that it continues so to do until it is entirely consumed. All that is left of it is the ash, or the earthy matter which already was oxidised as it existed in the wood, or which forms oxides which are solids under the conditions there present. All the constituents of the wood which can combine with atmospheric oxygen, do so, and form gases which are not visible and which pass off into the air.

As the teachings of Lavoisier are now accepted by all who are in anywise competent to judge of them, we are safe in assuming that combustion is the act of combining with the oxygen gas found so abundantly in the air. During the process, new bodies are formed and these are usually invisible gases which escape unseen into the atmosphere, as in the case of common lamp oil. Generally, there are formed, not only gases which escape, but solid ashes which remain, as in the cases of wood and of coal. But there may result a solid only, as is shown in the combustion of iron. The black smoke seen arising from chimneys consists of minute particles of solid carbon which have escaped oxidation and which are floating away in the arising gases. Wood and coal, indeed all matter which has ever enjoyed life, slowly are decomposed when exposed to the atmosphere, until at last there left only dust. All the remainder is oxidized and escapes as gas. In such cases we discern no liberation of either heat or light. But if the same matter be put into a stove and be there heated to the kindling temperature, oxidation then becomes rapid and both light and heat become evident to us. If for the words light and heat we use the word energy, which means both of them, we may state at once that when a given weight of any substance is oxidized, the total energy set free is under all circumstances the same. In other words, if a ton of coal be permitted to decay in the atmosphere, it will liberate precisely as much energy as it would if burned in a stove, or burned anywhere else. And the same is true of all combustible matter whatever. When oxidation is rapid we can see its effects, when it is slow our senses are too dull to preceive them. But the total energy set free by a given weight of any body is always the same, whether that body be oxidized in an instant or in any other length of time whatever. If a pound of wood could be burned in a drill-hole in the same time as can be burned a pound of gunpowder, the wood whould prove rather the better explosive

All who are in anywise familiar with the subject are aware that the atmosphere is not the only source of available oxygen. Many solids give up readily their content of it, a fact put to practical use in the manufacture of the common parlor match. In one method of this process there is made a mixture of phosphorous with a definite quantity of water ; to this is added potash, chlorate and gum, both of which dissolve in the water present, which should be just sufficient to form a paste when all the ingredients are well rubbed up together. The match sticks are dipped in this mixture and are then dried. If one of them be drawn quickly over a rough surface, there occurs a flash of light and a slight explosion, followed by ignition of the match stick.

While phosphorus is so highly inflammable that it takes fire when exposed to air, it cannot ignite on the match stick because the outer coating of gum protects it. But when the match is struck the coating of gum is broken and some phoshorous is exposed ; at the same time, it is ignited because of the heat produced by friction. The burning phosphorus starts decomposition of the potash chlorate, which in turn gives up about 40 per cent. of its weight of oxygen. This latter burns both the gum and the phosphorus remaining, producing combustion so rapid as to afford a kind of diminutive explosion. In this illustration, it will be seen that combustion of the gum and of the phosphorous is supported by oxygen given up by the solid potash chlorate present. Atmospheric oxygen plays no part in the combustion of the match head, though it afterwards does so during burning of the match stick.

Potash chlorate is one of the many bodies the constituents of which are not held in combination with much tenacity. If it be rubbed in a mortar with organic matter, preferably with starch or dry white sugar, a series of slight explosions are heard and the sugar or starch is consumed. Friction of the pestle against the mortar produces sufficient heat to bring about combustion of the organic matter in the oxygen set free from the potash chlorate ; combustion so active as to amount to a series of sharp sounds. Indeed, if care be not used there is apt to occur a disagreeable explosion of the entire mass contained in the mortar. Bodies which decompose readily, like potash chlorate, are said to exist in "unstable equilibrium."

Potash nitrate, called also nitre or saltpeter, is another body which readily parts with its oxygen. The mineral graphite, or black lead, which is so refractory that it is used for pots in which to melt steel in the steel furnace, may easily be burned in melted nitre. Graphite is a form of carbon, which when exposed to melted nitre takes from it the oxygen it contains, and is itself converted into a gas known to us as carbon dioxide.

Combustion of phosphorous and gum in the parlor match-head, and of starch or sugar in a mortar, at the expense of oxygen abstracted from potash chlorate, and combustion of the refractory graphite in oxygen taken from nitre, are good evidence that some mixtures contain all the elements of self combustion. And he who has heard the explosions which follow when potash chlorate and starch are rubbed together, will thereafter be ready to admit that in some of these mixtures combustion may be so rapid as to amount to explosion.

In starting a fire with wood, the process is begun by splitting a piece of the wood into thin splinters which are piled loosely upon the place the fire is to burn. Upon the splinters, other and larger ones are laid, and lastly small wood is piled upon the splinters. The smallest pieces are ignited by a match and the fire is thus made. There is a good reason for each of these steps. Thin strips of wood are provided for ignition, because experience has taught that it is easier to heat a small object to the kindling temperature than it is to heat a larger one. Moreover, as combustion can occur on surfaces only, the object is to provide as much surface as possible on the wood to be ignited. And by splitting a block of wood into splinters its surface is largely increased.

Wood in the form of sawdust presents greatly more surface than it does when split into splinters. But sawdust does not burn freely, because it lies in such a compact mass that air cannot circulate through it. When sawdust is suspended in air and then ignited, it burns with rapidity. There is a well authenticated case of explosion which arose from ignition of tanbark dust floating in the air of a barkmill in the State of Pennsylvania. In this accident, men were injured, two horses were killed and the mill was wrecked. There were present all the conditions necessary for rapid combustion. The air in the mill was thick with inflammable matter in the form best adapted to combustion. The bark, being in the form of dust, presented the greatest possible surface; and each grain of dust was surrounded by a film of air. When the first grain of dust was burned, it heated its neighbors to the kindling temperature, and in turn each grain was ignited. Thus combustion spread through the mass, and with such rapidity that the effect was at last an explosion.

There have occurred several similar explosions from wheat flour in the air of mills. It was from this cause that the Tradeston mills at Glasgow were destroyed in 1872, and since then two great mills have been wrecked at Minneapolis.

From these instances, the lessons to be learned are these :

1st. That combustion occurs only upon surfaces ; therefore dust burns with great rapidity because it presents the utmost surface for a given weight of matter.

2nd. That combustion when sufficiently rapid produces all the effects which we ascribe to explosion.

As we have learned already, when a body burns it is converted to hot gases which escape into the air. It is a fact easily proven that these gases tend to occupy far more space than was taken up by the matter burned. Every man who has fired a blast in a quarry has indeed proven that for himself. The hotter the gases are, the more space they tend to occupy. When dust in a mill is by combustion converted quickly into hot gases, the simple expansion of the gases bursts the buildings.

Gunpowder is another of the rapid burning mixtures, and much like that on the parlor match head. It consists of a mixture of sulphur and charcoal, which will burn, together with potash nitrate (called nitre), which will decompose and thus set free the oxygen necessary to burn them. These ingredients are moistened and are then thoroughly ground in a mill, which not only reduces them to dust but mixes intimately the dust of them all. The resulting mass is granulated into grains of various sizes, which are then dried.

It will be seen that each powder grain consists of inflammable materials together with a body ready to give up oxygen sufficient to burn them. Moreover, all these bodies are present in the form of dust, the condition in which combustion may most quickly occur. When a mass of such powder grains is ignited at any part, the hot gases of combustion force themselves among the grains and so quickly ignite the whole mass. Combustion is so rapid that it produces the effect we call explosion.

According to the statements of a writer whom we may freely trust, the gases generated by combustion of gunpowder occupy about 300 times the space the powder did ; they occupy that space after the gases are cooled to the ordinary temperature and pressure of the air. As hot gases occupy far greater space than they do when cold, it will be seen that the space occupied by hot gases from burned gunpowder is enormously greater than the space occupied by the powder which produced them. Or to put the same expression in another form : if the hot gases from gunpowder be confined to the space originally occupied by the powder, then will the pressure produced be enormous. Capt. Rodman got pressures of about 185,000 pounds to the square inch when testing the force which bursted bomb shells intended for 12-inch guns. The chambers within these shells were a little less than 4 inches diameter, and they were completely filled with the gunpowder. Applying Rodman's results to the pressure exerted in a 2-inch drill hole filled 8 inches deep with powder, we find that at the moment of explosion the total pressure upon the walls of that 8 inches depth of hole amounts to about two thousand three hundred tons. There is little wonder that rocks are split by blasting them.

Anything which impedes the passage of flame among the grains of gunpowder, causes the mass to burn more slowly. Sawdust acts in this way, and it often occurs that a pound of powder mixed with an equal bulk of dry sawdust will in a drill hole do as good execution as would two pounds of powder. The more slowly burning compound allows time in which the rock may crack, and its fragments begin to move, while with a more rapidly burning mixture much of the explosive force is consumed in simply crushing the resisting walls of the drill hole.

Reducing the powder grains to dust lessens the rate of combustion by decreasing the spaces in which flame can pass through the mass. These free spaces are still further reduced in size when the mass is dampened and then dried, and by pressure they may be so reduced that flame cannot pass through them at all. In that case, they can burn only upon their exteriors, where they are heatad to the kindling temperature

Fuses for bursting military projectiles are made by compressing dampened gunpowder dust into long thin cylinders, which fit in a chamber passing through the wall of the projectile. When the gun is fired, the exposed end of the cylinder is ignited and thereafter burns slowly until combustion reaches the bursting charge within the projectile.

To sum up so far—Gunpowder is an intimate mixture of charcoal and sulphur which are combustible, together with nitre, which will afford the oxygen necessary to their combustion. It always requires appreciable time in which to burn, but it may be in a form which will do so with great rapidity; and therefore it comes fairly within our definition of an explosive; a body which, when ignited, burns with great energy, or decomposes with great violence. It may be made into a mass which will burn slowly, as in the case of a fuse for a military projectile. But in all cases, it can burn without the presence of air, because one of its constituents can supply enough oxygen to afford combustion of the combustible matter it contains. What we have to bear in mind especially is this: that gunpowder always decomposes by combustion, precisely as does wood in a stove or oil in a lamp. This fact separates it from the most important of all of our modern explosives.

The explosive material in a common percussion cap belongs to a class of bodies called fulminates, bodies which are formed by the action of ammonia on certain forms of mercury or silver. All of these fulminates are violent explosives. A sudden shock, or even a scratch from a pin, is sufficient to bring about detonation in this class of bodies. They may be regarded as chemical compounds the elements of which are but slightly held together, so slightly that even a pin scratch affords sufficient agitation to bring about a sudden and total freeing of the bonds which held the elements chemically together.

When a fulminate decomposes, its elements are set free in the form of gases; it is the instantaneous liberation of these highly expansive gases which produces the effect we call explosion.

It must be true that the elements of fulminates are held in chemical equilibrium, or they would not remain combined at all. But the bonds are weak, the equilibrium is easily destroyed. In a word, it is unstable. Slight agitation or shock destroys it, and in an instant the fulminate is converted into highly expansive gases. We may define a fulminate as being a chemical compound which exists in unstable equilibrium, so unstable that slight agitation destroys it and permits the elements of the fulminate to dissociate into gases. It is this instant dissociation which produces the violent activity we observe when a percussion cap is exploded.

The chief difference between gunpowder and a fulminate is this: gunpowder is converted into gases by combustion, requiring appreciable time; a fulminate is converted into gases by simple dissociation of its elements, requiring no appreciable time. It is the suddenness of the dissociation, the setting free of the total energy in an instant, which produces such extreme violence.

Those who have studied the matter say that a musket ball cannot be propelled far by a charge of fulminate. There is indeed developed sufficient energy, but it is consumed in compressing the ball and in enlarging the bore of the musket, but a small part being active in driving the ball forward. The explosion is so sudden that its energy is largely expended before the ball has time to begin its flight.

In the year 1846 Sobrero discovered that when a mixture of strong nitric and sulphuric acids were made to act upon glycerine maintained at a low temperature, there was formd a light yellow, oily liquid, of peculiar qualities. The oil is 1.6 times heavier than water, in which it is insoluble. At 40 degrees Fahrenheit it freezes. When a film of it is struck with a hammer, or otherwise is exposed to sudden shock, it explodes with violence. It acts in the same way when heated quickly to 306 degrees Fahrenheit. But if cautiously lighted by means of a flame, it burns slowly and much as do the ordinary oils. This is the body now so familiarly known to us as nitroglycerine; or somewhat more accurately as glyceriltrinitrate.

Like the fulminates, this body exists in unstable equilibrium. It is a body in which the chemical bonds are weak and are easily destroyed. When this occurs, the mass is instantly converted into comparatively enormous volumes of hot and highly expansive gases. It will be readily understood that it ought to be, as it is, one of the most violent explosives known to chemistry.

The danger arising from the use of a body so readily exploded, caused Nobel, in the year 1867, to search for means whereby its violence might in some degree be lessened. He observed that when the oil was absorbed in sand, it might be handled with comparative safety. When a small mass of the mixture was permitted to fall upon a hard surface, it did not explode. Such a mixture could be kindled with flame and in that way slowly consumed. Evidently, this valuable agent could be brought into general use provided it first were absorbed in sand, or some similar sponge. The difficulty lay in the fact that sand could be made to hold but a small percentage of the oil: if more oil were used, the mass became too soft to handle, and then was almost as dangerous as the pure nitroglycerine. Nobel reasoned that sand could hold only so much oil as would adhere to the surface of its grains. If more oil were used, the mass became partly fluid. He saw that the problem might be solved if only he could get sand each grain of which contained a cavity within it; for then would the grains not only hold the oil upon their surfaces but within the cavities as well.

There were known to exist in Germany beds of what, there, was known as Kieselguhr, and in English, known as infusorial earth. These beds are composed almost entirely of siliceous shells which once were inhabited by minute infusorial animals called diatoms. When seen under a microscope, the shells are found to be of various forms, all of which are chambered something after the form of a snail shell or like the broken pieces of a common clay pipe stem. It was this kieselguhr, or infusorial earth, which Nobel finally hit upon for forming the sponge in which to absorb nitroglycerine. By using as little as one-fourth of infusorial earth, to three-fourths of the oil, he made a mixture in all ways satisfactory to him. He called the mixture dynamite, and so it continues to be called by us. Since Nobel's time, the only change made in dynamite consists in varying the proportions of nitroglycerine and the abbsorbent: all dynamite is not of the same strength.

Dynamite may be handled with comparative safety. It does not explode when permitted to fall from the hand upon a hard surface. Heavy waggon wheels may in safety be passed over a cartridge of it. It is slow to catch fire, but when inflamed it burns somewhat fiercely. When burned under any pressure, or if a large quantity of it be inflamed, explosion may ensue and likely will.

Both nitroglycerine and dynamite are readily and surely exploded by the shock of a detonating fuse. In ordinary use, an exploder containing mercury fulminate is fixed to a safety fuse, and is then put into the midst of the mass to be exploded. When the fuse heats the fulminate to its dissociating temperature, it explodes; the ensuing shock causes the nitroglycerine to dissociate into its volumes of hot and highly expansive gases. The explosion is so nearly instantaneous that destruction may result before even air has time to move away from before the expanding gases. It is for this reason that large masses of stone may be broken by means of the shock of exploding nitroglycerine which lay uncovered upon the surface of the stone.

Guncotton is another of the high explosives familiar to all the older ones of us. Chemically it is known as cellulose-trinitrate, and, therefore, it stands near to the glyceril-trinitrate which we have just been considering. Both have much the same characteristics.

The salts of another nitro compound, picric acid, form another class of high explosives, all of which are similar to guncotton and to nitroglycerine. All of them explode through dissociation of their elements, and therefore all of them are violent.

The modern smokeless powders are formed from nitro compounds, such as we have just been considering. The effective parts of them are nitroglycerine, guncotton, salts of picric acid, or some similar nitro compound. When exploded, they are converted entirely into invisible gases; there is left floating in the air no solid black carbon, such as happens when gunpowder is burned.

Gold Mining in the County of Beauce, Que.

By Capt. W. Prideaux.

Along the valley of the Chaudiere free gold has been found in nearly all the creeks and rivers discharging into the Chaudiere River from the River des Plantes at St. Francis to the River du Loup at St. George, more especially on the north-east side of the Chaudiere Valley, and in some places extending several miles back through those creeks and rivers.

The River du Plantes Valley has been worked by several companies from time to time, and a large quantity of gold has been taken out.

Following up the Chaudiere Valley to Bertrand Creek, near St. Francis Village, free gold has been found in the alluvial deposits along the banks of the stream. A little above the village is the Poulin Creek where free gold has also been found in several places along the banks.

A little further south is "Devil's Rapids" on the Chaudiere River, and in dry seasons when the water is low, these rapids have been worked by miners in a very small way, for many years.

The method employed is to build small dams so as to turn the water off and clean out the crevices between the ledges of rock, then wash the gravel by panning or with small rockers, and large quanties of gold have been taken from those crevices, and, some very large nuggets have been found at different times, and only last summer a nugget was found by one of the miners which was sold for $53.00.

There are several quartz veins crossing the river at the rapids, and, it is my opinion, that the free gold found in these crevices comes from these quartz veins, and I have no doubt but that some very rich mines will be found there.

Then we pass on to Veilleux Creek, near Gilbert Village, from which alluvial gold has been taken out at several places near its source, and the same applies to Bolduc Creeks, somewhat further on.

The next location is the famous Gilbert River Valley, from which several hundred thousands of dollors worth of gold have been taken out.

I suppose there has been more gold found in this valley than in all the others put together. Several companies and numerous individuals, having worked along this valley for many years, from the Chaudiere up to the end of the third range, a distance of about four miles, and many rich deposits have been found.

In the old channel (or river bed, as the miners call it) the lead varies in depth from a few feet in some places to over one hundred feet in others, so that most of it has to be worked by sinking shafts.

I came out here from England in 1879 to superintend the Canada Gold Company's alluvial claims on the Gilbert river. We commenced work on lot 12 in the second range, and worked through lots 12 and 13 to Concession road between ranges two and three, a distance of between 1200 and 1300 feet and averaging about 150 feet in width. In some places we worked it 180 feet wide.

We sank six shafts on that part of lead, about 200 feet apart, and I found that 100 feet from shaft was quite far enough to wheel the stuff, and we could do the work cheaper by sinking shafts than wheeling long distances. In some of the shafts we met with very troublesome ground to sink through, and it required a practical man, and one that thoroughly understood the work, to get through the quicksands.

In starting our shafts, we first lay two long bearers across the surface, and commenced timbering with sets of 8 inch square timber 3 feet apart, and, always drove our splicing laths ahead. The sets were either hung in chains or one inch bolts, and all the sets bolted together. The shafts sunk by us averaged about 60 ft. to the bed rock.

The first part of the sinking was generally through hard pan or gravel and clay mixed; then quicksands. In some places this was only about one foot in thickness, but in others seven or eight feet. This we found very difficult to sink through, then pipe clay, and after that lead gravel varying in thickness from 3 to 8 feet, to the bedrock.

In sinking our shafts, as soon as we reached the clay we puddled from that to the surface in order to keep the water back, which came through the quicksands, and surface gravel.

The shafts were then timbered by cover binding (or what is termed by some miners, grovendering), when the shaft is bottomed or bedrock reached we commenced drifting in opposite directions from the shaft.

The size of drifts are usually 6 feet high by 8 feet wide, and timbering is first done by laths put across the drifts supported by 4 inch temporary posts. When we had drifted 10 feet we cleaned the bedrock, then put up two caps of abont 12 or 14 inch square timber, and two posts under each cap of the same size, standing on the bedrock, which is generally slate. When the main drifts were run about 50 feet from shaft, we commenced cross-cutting and blocking out, and after a few drifts are worked out around the shaft, the weight becomes very great on the timbers, and we had to build stone walls under each cap in the main drifts to keep these open for wheeling through and it required two men constantly employed about that work.

We drifted about 30 feet, and cleaned 240 square feet of bedrock in twenty hours work, producing on an average about 56 cents per foot, or 7½ ounces per day.

The part of the lead we worked on was, however, not as rich as some other parts in the valley. Many large nuggets have been found along this valley varying in size from ½ to 7 or 8 ounces, others having brought as high as $450 to $1,000 per nugget.

Most of the alluvial lead along this valley, I think, has been worked out, but I do think if capitalists could be induced to come in, and work the quartz veins, rich mines would be found and large profits made, as the fact of so many rich deposits of free gold having been found along this valley from the Chaudiere to the third range, leads me to the conclusion that there must be some very rich quartz veins somewhere in the neighborhood from which this gold comes; as my experience was, that wherever we crossed a quartz vein (large or small) we got better pay than at any other place.

I came across one small vein of decomposed quartz, about 10 inches wide and sunk about 8 feet on this vein, and every pan that I washed produced a large number of small colors of gold, and when that is found at a depth of 8 feet I think it shows that the gold must be produced from the quartz.

On the hills above this valley there are also several quartz veins, in Ranges 5 and 6, which run back through the Township of Cranbourne. Some of these veins produce gold, on one of which I had some work done, (which is quite 6 feet wide,) and a sample from it assayed by Dr. Donald, of Montreal, produced $23.00 in gold to the ton.

Some two or three companies have operated on the Cumberland Valley, in St. George's; several shafts have been sunk along the banks of this stream and gold found in some of them, but I understand not in paying quantities. I am, however, of the opinion that the main lead has not been struck in this valley.

The Famine River Valley has been pretty well explored for several miles back from Chaudiere, but no deep leads have as yet been discovered. Parties have worked near the Falls and taken out quite a lot of gold, and there was a shaft sunk near the junction of the Famine and Beneka Rivers, and some nice coarse gold found at the bottom. They drifted a short distance, but did not find much, so it was abandoned.

The next creek south of Famine River is at St. George's Village. On this creek about one mile back of the Chaudiere there was a deep shaft put down. It was reported that they found lots of gold, but I am doubtful, as it was soon abandoned.

On the River du Loup, above Jersey Point, operations have been carried on by several companies, and a large amount of gold is reported to have been taken out. Mr. Blue, of Capelton, I understand, is now testing some of the veins along the banks of this river, and the chances are that he will strike something good.

The finding of so much gold in all the rivers and creeks with so many promising quartz veins traversing the hills above, I do not think there is a richer district for gold on this continent, or one more worthy the attention of capitalists, than the county of Beauce, and the time will no doubt come when there will be a rush to this country for gold properties.

Explosion by Lightening at a Nova Scotia Colliery.

In a recent paper before the members of the McGill Mining Society, Mr. T. Farmsworth, Westville, gives the following particulars of the explosion a few years ago at the Drummond Colliery, Westville :—

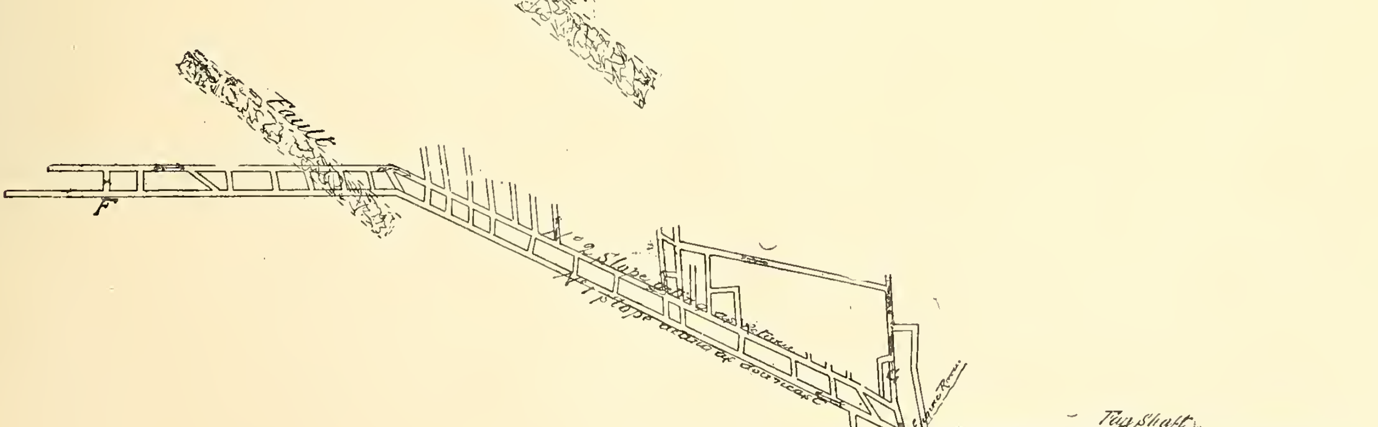
Personally I have not read of any mine explosion having been caused by a thunderstorm. In the present case I shall be able to lay before you, and as concisely as possible, indisputable facts of one mine explosion having been caused thereby. I wish to refer briefly, however, to a peculiar phenomenon which occurred some years ago at the Kibblesworth Colliery, England, during a very heavy storm. An electric current undoubtedly passed down the slope and into the mine. The rope on the slopes travelled at a very slow speed, but with a heavy load. The working load of the rope at the time was 40 full tubs or boxes and 40 empty ones. The average force tending to move the rope would consist of the weight of the coal in the full boxes multiplied by half the total rise, and by the rate of doing the work. The weight of the coal roughly was some 40,000 lbs. This was raised 33 feet vertically in 18 minutes, which would give about 2 h. p. In the ordinary routine of working during this storm the rope with the load came to a halt, the men and the boys employed in the mine received shocks, consequently electric currents must have passed through them. Especially is the case of one boy clearly illustrated. This lad, a brake holder, received a severe shock, having his hands on the brake and his feet on the rails he must have been one of the joining points or objects between which an electro-motive force existed, the rope being charged one way say positively and the coals, rails, etc., negatively. It is probable, too, that some of the most powerful shocks were produced by redistribution going on at the time owing to the clouds having flashed and so altered their electrical condition. The case, however, of putting a stoppage to the load seems to me a most peculiar phenomenon and worthy of consideration. Mr. Lougden, Engineer, England, gives his reason as this : 'There are 320 wheels in all on the tubs, leaving out of account the rope and its pulleys. Supposing therefore an attraction to be set up between each individual tub-wheel and its rail, due to the existence of electro-static charge, assisted possibly by very minute traces of magnetism, it is by no means an impossible contingency that the aggregate holding force should be sufficient to hold the rope.' Something of this kind evidently must have been the cause as the rope moved on immediately the inducing force was removed.

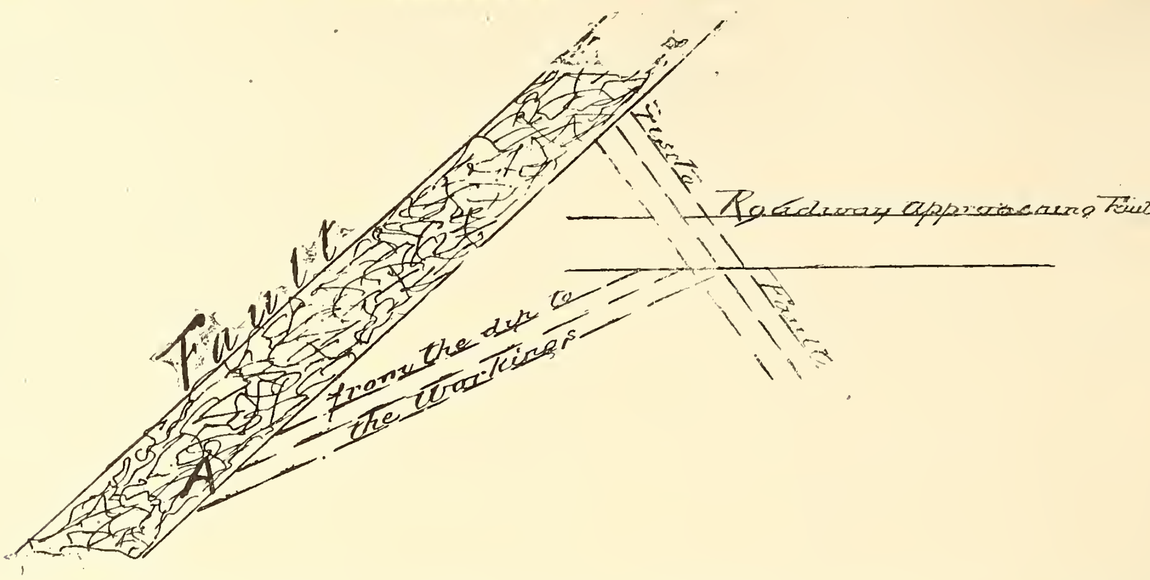
In passing on to the case of an explosion having been caused by one of these electric storms, I must first give you a brief description of the state of the mine for some short time previous to this, and enclose tracings of portions of the workings on an enlarged scale.

For some few months all work had been abandoned, no decision having been come to as to a thorough and comprehensive system of laying the workings out to the best advantage, having three faults or dykes to contend with. The lower or deep fault when struck in the sinking of the slopes, gave off considerable feeders of gas at a very high pressure, showing that a large draining ground had been opened out by the piercing of this "step." This was proved by the fact that at the last cross-cut in the slopes, marked F on plan, there was an air current of 20,000 cubic feet per minute with a velocity of 350 feet per minute ; notwithstanding this strong current, and really only ventilating two working faces the back or return slope was very heavily charged. The slopes were sunk some 1,200 feet after passing through the trouble, but the angle the course of the slopes made with the course of the fault not being great, the whole of this distance was simply one drainage ground. In speaking of gases coming at pressure from faults should you know the dip and course of the fault particular notice should be taken of the manner in which the "lips" or smooth faced fissures come in when approaching the trouble in your workings. Below I give a sketch which will better illustrate my meaning. In one case you will note the "lip" running upward and toward the fault from your workings ; you will in this case, in all probability, not encounter much difficulty unless the gas be pent up at high pressure. In the other case you will note that the "lip" commencing say at point A rises from thence up toward your workings, thus forming a natural drainage ground of itself, more special care being needed in the matter of your ventilation.

During Friday, the 8th day of August, 1893, a heavy storm of thunder passed over the neighborhood of the works and simultaneously with a destructive flash of lightening the mine exploded with a terrific force completely demolishing a cupola 60 feet high over the fan shaft, tearing asunder the wrought iron tubes connecting the mine with a Schiele ventilating fan. The current was seen to strike the steel wire rope which hung down to near the bottom of the shaft and on which hung the cage for raising and lowering men and material ; from this shaft were placed water column pipes leading into the mine from the shaft and down the sinking slopes into the workings. This inductive force evidently passed down the rope and from thence to these pipes and then into the workings igniting the already formed gaseous mixture. About three minutes after the explosion occurred dense volumes of smoke emerged from the three shafts, Thinking the workings were on fire it was decided to seal the mine up entirely. This was done by first battening down the downcast shaft marked A and then simultaneously the hoisting and fan shafts. The reason for this course was that by first stopping your main intake you robbed the mine of a large portion of fresh air needful for combustion and thus lessened the possibility of a second explosion taking place. In putting in the stoppings at the mouth of each shaft squared timber, 10 inches diameter, was used, and over this 3 to 4 feet of clay well rammed was placed, thus excluding all air and damming back the smoke and "after damp" into the workings.

The first commencement to open out and recover the mine was made by way of the fan shaft, this so as to make every preparation as speedily as possible for the restoration of the ventilation. The method adopted after careful consideration was by first removing from the top of this shaft a small portion of the clay, then with an auger a small hole was made through the timbers and chiselled out to about 3 inches square; through this aperture a self-recording thermometer was run to the bottom of the shaft and the temperature (57 deg. F.) noted. The mixture exuding from this hole gave us 14.7% of CH_4 and at a very high pressure. This gaseous compound of carbon and hydrogen more nearly approached the nature of illuminating gas than that of fire damp, a large percentage of air being needed to make an explosion possible. A pipe was then erected 12 feet high, carrying the gases well into the atmosphere. You will perceive from this the necessity of exercising the utmost care in dealing with mining trouble of this kind. The shafts were left in this condition for three days, then as the pressure and nature of the exuding gases had changed and no smell or other sign of fire was noticed, the whole covering was removed and a commencement made to build up the crib work, to restore the ventilation, and make a descent into the mine. A commencement to run the fan was made some three weeks after this and a descent commenced by way of the downcast shaft. Previous to the explosion there were two check doors in the cross-cut, marked D on plan, to enable persons to travel from the intake to the return ; these were totally destroyed. No air, however, was noticed travelling through this headway and thus by a very short circuit to the fan. It was, therefore, naturally concluded that a fall of roof must have occurred, closing up the roadway. This was not the case. A direct, clear passage existed to the fan shaft bottom. Notwithstanding this no perceptible amount of air travelled this the natural course. From this point to the second main landing down the shaft slopes each successive stopping was demolished, the greater part of them being three feet in thickness. Here, then, we have another phenomenon confronting us. Notwithstanding the fact that there were short circuits in which the air could travel from the intake direct to a fan of 30,000 capacity, yet we find it taking the longer course down the mines and through the workings and thus defying all the known laws of ventilation. If you gentlemen in your discussion can throw light on this point, I, with others, will be benefitted thereby. I am sorry not to be able to give you the two temperatures, that of the in-bye and out-bye air, as from this I think we might formulate a reason. It is certain the air entering the mine and when passing this roadway D would be much heavier than the return air passing from the mine and up to the fan. This difference of density must have been the chief reason, that is, it was less work for the fan to take this light air from some 3,000 feet down the workings than to take the heavier air along this narrow circuit and lift it up the shaft. The chief falls of roof were found in the immediate vicinity of the hoisting shaft.





At the point shown on plan, and colored red, four separate and distinct forces seem to have met. Here you will notice a point marked as engine room ; this engine having been used for hoisting the coal up the slope, colored blue. On the high or return side of this room a stopping was erected in which a regulator was placed to air the engine room. This stopping was blown outward from the return side and through the engine room ; then came another force from the district marked G and shaded green, then the two forces from the No. 1 and No. 2 slopes ; each of these forces meeting at the point shown did considerable damage. A small boiler placed here and used as a steam receiver was carried bodily at least 30 feet. Although at this particular place no sign of fire damp could be detected on the lamp, that is on the level road, yet when climbing over the top of one of these falls of roof, our lamps perceptibly brightened and an immediate sensation of weakening at the knees was felt, accompanied by dizziness in the head, caused by breathing the carbon mon-oxide C.O. laid in this high cavity and produced by the imperfect combustion of the particles of coal dust floating in the air at the time of the explosion ; this gas in the sluggish state of the air current stratifying naturally and remaining in these high and abnormal excavations in the roof.

Here then we have several points worthy of consideration in dealing with any explosion more especially when you have a fear of mine fires and you find it impossible to penetrate the workings immediately.

1st. The careful closing of all openings, studying the most secure and least dangerous method of doing so, then deciding quickly and unalterably (no indecision) the mode of procedure.

2nd. Equal care to be bestowed in the re-opening so that you may ascertain by all existing means the nature of the air of your mine and its temperature.

3rd. The careful starting of your fan and restoration of ventilation. In case of any smouldering fire the commencement of your air current means another and probably more disastrous explosion than the first.

I must say in conclusion that we were favorably situated as regards the closing down, no lives being in the mine, consequently no time need be lost in trying to recover them, which would in this case have been impossible and useless.

I may say that the total damage was comparatively slight, due no doubt to having three openings to the surface by which the force generated could be expended.

The Phosphate Trust.

Boodler Sando Examined in Bankruptcy—More Side Lights on Phosphate Finance.

Our readers who have followed the REVIEW's report of the doings of the General Phosphate Corporation, (Ltd.) from the date of its inception to its liquidation will be interested in reading the account of Sando's examination in bankruptcy in London last month. Mr. Knud Sando, the promoter of the swindle, appeared before Mr. Registrar Hood, and said he wished to deny the statement which had been made that he was an undischarged bankrupt when he was negotiating with the corporation. He had received an order of discharge immediately upon applying for it, in 1880, to the New Zealand Court. He came to England about the beginning of 1887. The Phosphate Trust was proposed about September, 1889, another scheme having fallen through. He had made a study of phosphates, and came to the conclusion that the industry was a good one, and he decided to make an effort to form a company to take it up and work it. He discussed the matter with Messrs. Francis and Johnson, and it was decided to organize a company with a capital of £1,000,000. The late Mr. Hume Webster agreed to promote the company. Witness was acting as the agent for owners of Canadian phosphate properties.

The original intention was that the Phosphate Trust should purchase certain properties in Canada, covering about 11,000 or 12,000 acres. Under this scheme the directors were to be bound to purchase the properties ; but the proposed directors declined to agree to this course, preferring to be entirely unfettered in their choice of properties. In March, 1890, the whole scheme was dropped and a new one entered upon, the company being eventually called the General Phosphate Corporation (Limited.) Witness held several options from phosphate property owners, under which he was to receive commission if sales of the properties were effected.

The "Ross Mountain" group was purchased for £55,000, and when the directors informed him that they were favorably impressed with the property he saw the Hon. C. C. Colby (the vendor) and arranged that he should receive as commission an interest of £5,000 in the mortgage which was executed upon the purchase. The "High Falls" group was acquired by the company for $40,000, and witness received as commission an interest of £11,000 in the mortgage of £30,000 on the property which was executed to secure the balance of purchase money. Before he left Canada in September, 1890, witness gave Mr. Deeley 20 founders' shares, representing £1,000, for services entirely outside the company. Sometime afterwards he agreed to buy the shares from Mr. Deeley for £1,000. Mr. Deeley had used his influence in obtaining the co-operation of two members of parliament in a large colonization scheme to which he was giving his attention. He had no knowledge of any commissions having been paid by the vendors to the experts who reported on the various properties to the company.

Under a contract dated June 12, 1890, witness undertook to obtain subscriptions for 300 founders' shares, representing a total amount of £153,000. On July 4 following applications were made for 183 founders' shares, representing £93,330. At the board meeting held on that date it was resolved that 117 founders' shares, representing £59,670, should be allotted to witness on the condition that his cheque for £6,000 was honored. At that meeting the directors declined to go to allottment until he had completed his contract. Witness then offered to apply for the shares on his own account, and the directors agreed to this, subject to his giving a cheque for £6,000. He told the directors that he had not the money at his bank, but would make arrangements to meet the cheque.

The Official Receiver—What was your financial position at that time ?

Witness—I had all the money that I wanted. (Laughter.)

Continuing, he said that he paid £500 in cash and gave 20 founders' shares for an advance of £3,000, which he repaid within 18 days. He asserted that it was a very common occurrence for 300 to 500 per cent. to be paid for advances in respect of preliminary expenses of companies. He borrowed the money to pay the registration fees. He had a group of persons around him who financed and assisted him and who received a share of the profits. The directors knew that he was receiving a commission, but they never asked him what it was, and he never told them.

The inquiry was adjourned until May 7 next.

ONTARIO MINING INSTITUTE.

Second Annual Meeting.

The second annual general meeting of the members of the Ontario Mining Institute was held in the School of Practical Science, Toronto. The opening session was held on Wednesday afternoon, 10th April, when Mr. W. Hamilton Merrit, A.R.S.M., F.G.S., in the absence of the President, occupied the chair.

After the Secretary had read the minutes of previous meeting, the following were elected to membership :—

New Members.

Mr. J. Burley Smith, M.E., Glen Almond.
Mr. Frank Darling (Canadian General Electric Co.), Toronto.
Mr. Herbert C. Hammond (Osler & Hammond), Toronto.
Mr. W. E. Bousted (School of Practical Science), Toronto.
Mr. J. W. Shields (School of Practical Science), Toronto.

Mr. G. R. Mickle, M.E., Sudbury.
Mr. W. A. Parks (Biological Building), Toronto.

Amendments to Institution and By-Laws.

On motion of the Secretary, the following amendments were adopted :—

SECTION III.

PAR. III.—"The Institute shall consist of Active, Associate, Honorary and Student Members."

PAR IV.—That the paragraph be changed to read "Active Members," instead of "Members," as formerly.

That a new paragraph be added as follows :—"Student members shall be persons who are qualifying themselves for the profession of mining metallurgical, mechanical or electrical engineering, or other branches of engineering, and such persons may continue student members until they attain the age of twenty-five years. They shall have notice of and the privilege of attending all meetings and excursions, and shall have all the privileges of the Institute, except voting. Student members shall pay an annual fee of one dollar."

SECTION V.

That the membership fee be three dollars instead of two dollars.

SECTION VIII.

That a general meeting, for reading and discussion of papers, be held once in each year, instead of twice as formerly.

Treasurer's Report.

Mr. T. W. Gibson submitted his annual report, showing a balance on hand of $14.50, with assets and liabilities about even.

The report was adopted.

Secretary s Report.

The Secretary—A year ago to-day our Institute was organized, with a membership of 37. It has grown to 79, or an increase of 42, during the year. Meetings have been held as follows :—

Rossin House, Toronto, 10th April, 1894, one session ; Private Bills Committee

Room, Toronto, 12th and 13th September, 1894, four sessions; School of Mining, Kingston, 3rd and 4th January, 1895, four sessions.

Ten papers had been contributed to the proceedings as follows :—

(1.) The Utility and Value of Some Common Minerals, by Mr. A. Blue, Director of Mines.
(2.) The Nationalization of the Mineral Domain of Ontario, by Mr. J. Bawden, Kingston.
(3.) The Rainy River Gold District, by Dr. A. P. Coleman, Toronto.
(4.) Nature's Concentration Works, by Dr. W. L. Goodwin, Kingston.
(5.) Gold in Ontario and its Associated Rocks and Minerals, by Dr. A. P. Coleman, Toronto.
(6.) Boron: Its Detection in Minerals and Uses, by Prof. W. Nichol, M.E., Kingston.
(7.) Notes on the Merchantable Mica of the Laurentian, by Mr. Hamilton Merritt, A.R.S.M., Toronto.
(8.) Notes on the Glendower Iron Deposits, by Mr. W. G. Millar, M.A., Kingston.
(9.) Notes on the Silver Deposits of Thunder Bay, by Mr. Peter McKellar, F.G.S.A., Fort William.
(10.) Notes on the Diabase Dykes of the Sudbury District, Ont., by Mr. T. L. Walker, M.A., Kingston.
(11.) Typical Ontario Rocks (illustrated by lantern microscopic views), by Mr. W. G. Millar, B.A., Kingston.

The other feature of the year's operations was the scheme of federating the various mine organisations, which had been considered and approved by the Institute, and had been finally adopted by the other societies.

Election of Officers.

PRESIDENT.

Mr. James Conmee, M.P.P., Port Arthur.

VICE-PRESIDENTS.

Mr. James McArthur (Canadian Copper Co.), Sudbury.
Mr. Ian Cameron, Sudbury.
Mr. Peter McKellar, F.G.S.A., Fort William.
Mr. J. J. Kingsmill, Q.C., Toronto.

TREASURER.

Mr. T. W. Gibson (Bureau of Mines), Toronto.

SECRETARY.

Mr. B. T. A. Bell (Editor Canadian Mining Review), Ottawa.

COUNCIL

Mr. A. Blue, Director of Mines, Toronto.
Dr. A. P. Coleman (School of Practical Science), Toronto.
Dr. W. L. Goodwin (School of Mining), Kingston.
Prof. Wm. Nicol (Sceool of Mining), Kingston.
Mr. F. Hille, M.E., Port Arthur.
Mr. R. W. Leonard, C.E. Kingston.
Mr. J. F. Latimer, Toronto.
Mr. W. Hamilton Merrit, M.E., Toronto.
Mr. T. D. Ledyard (Ledyard Gold Mines), Toronto.
Mr. Thos. Shortiss, Toronto.

The following papers were read at this and the other sessions of the Institute.

Determining the Value of Gold Ores in the Field.

BY R. W. LEONARD, C.E., KINGSTON.

At this time when there is a renewed interest in Ontario Gold fields, it is of peculiar interest to prospectors and owners of gold locations to be able to arrive at a fair estimate of the value and character of their ores, and of determining on the methods to be adopted for milling or otherwise extracting the value.

The ordinary method of taking hand specimens to an assayer gives results of little value except to indicate whether it is worth while to further explore the property.

A mill test of one or preferably, several tons is of course "the proof of the pudding," and—if properly carried out—gives all information that can be desired about the character and value of the ore sent to the Mill. Queen's College. Kingston, is now happily possessed of a three stamp mill for testing purposes in connection with the new Mining School. This mill will no doubt be of great value to mine owners.

There are, however, many discoveries made in districts so remote from railway or water communication or even from travelled wagon roads, that the cost of sending out a lot of ore for a mill test is so excessive as to cause the owners to hesitate before incurring such an expense.

It is to determine at a reasonable expense at the mine, the gold contents of such ores and the value that can be extracted by amalgamation that the writer proposes the following method which he has used and has checked with the ordinary assays and found very satisfactory.

A quantity of the ore judged sufficient to give a fair average value (say one ton) as broken to egg size on a close board floor (or preferably on an iron sheet) and carefully quartered (sweepings and all). The quarter is again broken smaller and again quartered. The part selected is then coarsely crushed in an iron mortar and sampled. A quantity of the same judged (by size of the shows of gold if any and the supposed value of the ore) sufficient for fair assay is now weighed and ground fine in successive lots in a mortar with water and a *small amount* of mercury until the whole weighed sample has been treated—using the same mercury for each lot. The whole weighed sample is now panned down to separate the amalgam and the concentrates from the tailings. The concentrates are dried and weighed and the *whole of the mercury used* is retorted in a small smooth cast iron retort. When all the mercury has been driven off, the retort is opened and a small quantity of test lead is melted in the bottom of the retort to collect all the particles of gold left from the retorted mercury. The lead is then poured into a mould and the litharge and scrapings of the retort are reduced on charcoal with the blow pipe and the resulting lead added to the first. The lead is now refined and cupelled with the blow pipe in the ordinary way and the resulting button of gold and silver is weighed, parted and weighed again in the usual way.

The dried concentrates (which are much more uniform in value than the free milling ore) can now be assayed by the blow pipe, or a small quantity can be sent to an assayor if the prospector is not sufficiently expert with the blow pipe. If the concentrates are sufficiently rich to be worth saving for further treatment the value can readily be obtained by the blow pipe.

The above method will give you more information and a more accurate assay than a fire assay as usually conducted, because it shows what proportion of the gold can be saved by amalgamation and what value remains in the concentrates, and because it is easy to treat in this way a very much larger sample than is treated in the ordinary assay.

The writer does not propose the above as anything novel—on the contrary it rather reverts to original principles—and some portions of the process will no doubt be familiar to many members of this Institute—still the writer believes there are very few who realize how correct and how valuable is the knowledge of an ore obtained by this method and while he does not propose it as a substitute for a mill test of a large quantity where a mill test is feasible, it is a better assay than any other that he knows of and can be carried out at a trifling cost at the mine with apparatus that a man can very easily carry.

A Recent Trip to the Rainy River Gold Fields.

By Mr. F. HILLE, M.E., Port Arthur.

I have to ask your pardon Gentlemen, for changing the theme of my paper, also for not making this paper as complete as I wished it to be written, on account of my present very limited time, which is also the reason why I could not take the pleasure of reading this paper "in persona," but had to accept the kind offer of my friend, Mr. Burk, to read it for me instead. Indeed, I have to ask your indulgence further, for choosing this subject for my present paper, because you have heard lately so much about the Rainy River District in particular, and about gold in general, that you might consider it too much of a claim laid upon your patience in listening to that theme again and again. Now I shall try to throw as much new light upon this subject, as is at my disposal at present.

Although the Seine River, the principal scene of the present gold excitement in the Rainy River District, is not a new acquaintance of mine from only a week ago when I visited it last. I trusted its waters at different times, in different seasons to carry me to its various borders, but this time, although not the most favorable season for exploration and examination, I looked over some places along its shores, which were partly new to me. The most interesting spot was again the lower, but northerly part of Shoal Lake and Bad Vermillion Lake, not only on account of the frequent occurrence of the precious metal gold, in the veins of the different rocks, but also on account of the geological condition prevailing there. Dr. Lawson in his excellent report on the Rainy River District, dwelt repeatedly on the possible forming of these rocks and in a very sagacious deduction, came to the conclusion that they constituted the products of a highly active volcano of Kewatin age. Undoubtedly they are, and I might add of perhaps "Post" Kewatin age, for the reason that these rocks are massive and compact and that the green schists made up of the tuffs and ashbeds, are seen overlapping the Kewatin highly tilted and foliated slates. These rocks must have been produced therefore in a comparatively quiet period. The granite at Bad Vermillion Lake forms the remainder of the lava in the former vent of the volcano, while the gabbro surrounding the granite its first extravasation. Next overlying the former, as the second ejectamenta, an altered granite (?) called Protogin, and on top of this rock the above mentioned chloritic rock which at the shore of Shoal Lake, is mixed with pebbles and boulders, now called Conglomerates. The protogin forms on Location A.L. 104, the highest point on the north side of Shoal Lake, with the exception of the Graniteboss on the south side of Bad Vermillion Lake, about two miles farther west. Dr. Lawson could not have seen very well the exposure of this rock unless he had penetrated the dense pine forest for half a mile on one side and one and a half miles on the other side from the shore. It is therefore excusable when he thought the green schists formed the contact with the Gabbro, as we can not expect that a Geologist should explore every square foot of the region he is going over.

Allow me, Gentlemen, to dwell a little longer on these rocks and especially on the protogin. The field appearance of the gabbro at the surface is that of a limestone owing to the decomposition of the anorthite, and that of the protogin as a massive greyish green coarsely crystallized rock, which on unaltered pieces shows by microscopical examination to be composed of much translucent quartz with dark spots as enclosures, some feldspar and a good deal talc or chlorite. If the latter is a metamorphic product after Biotite, the microscope might give us information about it, but I consider this of less importance, than the question "what was the cause, what the agency, that altered this rock, to what it is now?" Pressure? Well, that might have been the primary cause, and formed a favorable condition for the secondary, that is, for a chemical agency. Hot saline waters in a highly eruptive locality suggests itself as the simplest explanation. Now again, the action of such waters on rocks of different kinds was, especially in the latter Archean times, undoubtedly not a rare occurrence; but a rare occurrence must have been the forming of a rock of exactly the same composition, and also rare the happening that all circumstances in altering and changing this rock were found to be the same, acted the same and formed the same results. Because we find this rock in only a few localities, and in this province, yes, I might say on this northern continent, so far as I am aware, only upon a few places in the Rainy River District, and there, following in almost a straight east-north-east line, the water courses of the Seine Atti-Kokan, and appearing as far east as Ossinawee Lake, not in a continuous belt, but in wide intervals, as isolated little knolls. Is it accidently that we have found this rock so far only upon the above named places, because our travels through the country are principally done along the water courses? Or offered our earth's crust at that time especially weak spots, or a weak line in the neighborhood, or along the shore of an Archean Seas, whose beach pebbles and boulders, are found cemented together now, by the lava and ashes, that it was possible to form a group of volcanoes whose ejecatmenta are alike! Accepted this has been so, accepted further that the above-mentioned circumstances had prevailed, that hot mineral waters had acted upon the rock then we have to accept also the theory that these waters not only changed this rock, but have been also the agency which have dissolved the minerals out of it, existing therein and infiltered, and deposited them in the fissures of this rock. Wherever we find this protogin here in our western country, the veins have exactly the same appearance, the vein matter is the same, consisting of quartz, blende, copper and iron pyrites and galena, and almost in every instance gold free and combined, and also the sealbend is made up of the chloride or talc of the rock. Now I will not say that lateral secretion was the exclusive cause of the filling of the veins, although it is easier to accept, when one considers that the different minerals appear in vertical lines in the veins, and commence often on both walls with the same mineral, changing towards the middle in equal sequence. I observed another peculiar feature, that is, in the forming of the veins or fissures, they seem to radiate from one common centre which is caused perhaps by the magma being longest hot and viscid there where it was thickest and cooler and contracted therefore more slowly than towards its thinning sides.

Now, when we consider that this protogin is of eruptive origin and comparatively little altered by dynamic forces (perhaps with the exception of a little "rough shaking at times" which might have produced and opened some of the fissures still more) unlike those which prevail in Keewatin times and formed the rocks of that period to what they can be seen now to exist, as often sharply foliated and highly tilted slates, while this protogin still showing its compact and massive structure, then it is to be assumed that most of the veins therein should be of a "true character." If so, and if we consider further the often very rich mineralization of the veins, then, gentlemen, I am somewhat justified to have dwelled upon and kept your attention so long upon the occurrence of this rock, because it will play an important role in our gold mining camps as a rich and permanent producer of that yellow, much desired metal, gold.

To do justice also to the neighbors of this rock, to the slates much developed in the western part of the Rainy Lake and River District, we find in them sometimes very good and very likely also permanent veins, especially where they form the contact between the different series of the Huronian and these and the Laurentian rocks, but a large percentage of the veins in the slates show a bedded, or to use a more current expression, a gashy form. So much is certain that there are few gold-mining camps where the gold is so generally distributed in the numerous veins over so large an area as in the Rainy River District This area extends east to the Shebandowan Lake region and as far known, as far as 50 miles north of the Canadian Pacific Railway from where I received samples of ore last fall identical with those coming from the more southern and western district.

On my recent trip through the Seine River country, I observed the building of several concentrating mills on locations where the veins are neither developed, nor the people have an idea, of what character their ore is or will be, and if the machines bought are suited for it or not. Judging from my experience in testing the different ores over a period of six years, I have to say that a number of these machines are not adapted to our ores here, because they neither work economically nor profitably. Allow me to prove my assertion. As I remakred before, a large percentage of our ores, consist of quartz, blende, copper and iron pyrites and galena, also after taking them out of the workings, out of a certain amount of the country rock chloritic, talcoses and cerisitic in character and further some gold combined and free. The latter usually more so at the surface than farther below where the atmospheric influence ceases, yet in a great number of veins the gold will be found there exclusively combined with the pyrites, and also the other sulphurets greatly increased, therefore the ore will be distinctly refractory. Further we have to consider that there are no reduction works in the immediate neighborhood, the nearest are in Omaha and Newark, that the communications in that country yet, therefore the freight will absorb a large amount of the value of the ores or concentrates.

The machines generally used here are stamps, amalgamating tables and Frue vanners, or vanners of a similar type. Now we know that the stamp is not an ideal grinder, that it produces a large amount of fine muddy slimes, and the more so in disintegrating our ores here. The consequence is that these slimes are settling so tenaciously upon the common amalgamating table and even on the Frue vanners that there is often a great loss of leafy hammered gold particles as well as valuable concentrates. Furthermore, instead of separating the components of the ore, we receive them in our old method mixed together, thereby experiencing not only loss of zinc, lead and copper, by making a present to the smelting works, but also have to pay perhaps an extra cost for treating our high grade zincous concentrates, and increasing our shipping expenses enormously. Because instead of shipping the gold value (let us say from 30 tons of ore) in only one ton to the reduction works, we are sending it in perhaps five or even more tons. Expressed in figures: instead of having $40 shipping expenses we have $200, besides the expense for treatment, loss of the byproducts zinc, lead and copper, and also the expenses for mining and milling. Only a very rich mine can afford such extravagance, but surely not the most of the mines which will be opened in that country. Therefore, I consider it deplorable, that people commence already building mills, before they have a mine and before they know what they have in their mine, because the end result is usually a failure of the individual mine and a condemnation or drawback in the development of a mining camp.

On the other hand in using the right methods in milling our ores, we could make them pay very well, even if the ore is refractory. Yes I might say this refractory ore will pay in many instances, for the expenses in extracting the gold, by saving them and making use of them ourselves.

I said above that there are many bedded veins in that country which show quite an appreciable amount of gold. The nature of these veins would not justify the owners to erect mills for their own use, but it would be possible for them to realize something for their ore, if they could send it to a neighboring custom mill. Such a mill situated at Sturgeon Falls with a splendid water power all the year round, would have a central situation for some time to come, as the trend of the prospectors is eastwards up the Seine. But any individual or company who would build a custom mill there would find out later on he would have made a good investment.

But what a boon would it be for the people being, and going into that country, if the Ontario and Rainy River Railroad were built. Every one of us who has had experience in travelling in winter through this country surely realizes what a good investment a railroad is, but realizes also what a drawback the non-existence of such an institution is, in regard to a rapid development and prosperity of any newly opened region, and especially farming and mining camps. See the existence of the farmers on Rainy River, living on the richest soil that nature can produce, and knowing what treasures they could earn from it if they had a market. The same is the case with the miners, they are sitting on their treasures and don't know how to carry them into the market.

I thank you very much Gentleman for you kind attention.

MISCELLANEOUS.

Fort Steele Mining Association—This is the title of a new organization of mining men in the East Kootenay district, British Columbia. Mr. R. L. Galbraith has been elected president and Mr. Thos. McVittie, secretary. One of the chief objects of the association will be to bring under the notice of the investing public the various mineral opportunities of the Upper Columbia district of East Kootenay, which lie at present generally unutilized from lack of working capital. There are now signs of a renewal of energy in this mining district, to which the formation of the association bears evidence. It remains to be seen whether, as hoped, the efforts of the organization will result in the desired development of the mineral resources, of which, since the Robbie Burns claim jumping litigation, the outer world has really heard but little.

Hamilton Iron and Steel Co.—"A deal is in progress," says the Hamilton *Spectator*, "by which, if the negotiations are successful, the Canadian directors will buy out the American directors and assume entire control of the enterprise. The Canadian directors are J. H. Tilden, John Milne, and J. H. Landon, of this city, and W. Jaffray, of Toronto. The work on the furnaces is suspended at present, pending the completion of the deal, which is expected to be consummated shortly. If it is carried through J. J. Moorehouse will continue to hold the position of superintendent under the new regime, and everything will go on as projected, except that it will become a purely Canadian enterprise.

Kingston Mining School—A summer School of Science will be opened on 10th July, under the auspices of this institution. The object of the school is two-fold: first, to give to public school and other teachers an opportunity of studying the chemistry, mineralogy, geology, botany and zoology of the farm as recommended by the Department of Education; and, secondly, to enable teachers who cannot attend the University during the winter session to prepare for the practical part of the specialists' examination and the University examinations in the subjects mentioned.

An Improvement in Mine Cages—A new mine cage, the invention of Mr. Alexander Gray, is now in operation at the Leiter Mine, Sheridan, Montana. In this cage the chairs are made a portion of the cage, and by a slight pressure of a lever they can be thrown in or out at will. The station tender can never leave the chairs in, as they fly back as soon as the engine takes the load off of them. They can be used, and are very useful, in making repairs to the shaft, such as re-timbering, etc., as they will rest on any set of timbers, and the men employed in the shaft are said to feel safer resting on the chairs than if hanging by a rope.

The North American Graphite and Mining Co. Ltd.—Is applying for Dominion charter of incorporation. The objects of the company will be to acquire by purchase, a tract or tracts of mineral lands in the Province of Quebec and elsewhere in the Dominion of Canada, and to work and develop the resources of the same; to carry on the business of exploring for, mining and gathering graphite, iron, lead, nickel, copper, silver, gold and other metals, minerals and ores in such forms as the same may be found through the Dominion of Canada. The operations of the said company are to be carried on in the Township of Buckingham, in the County of Ottawa, in the Province of Quebec and elsewhere in Canada. The city of Ottawa is to be the chief place of business. Capital stock, $150,000, divided into fifteen thousand shares of $100 each. The names in full, and addresses and calling of each of the applicants are as follows: Nicholas Charles Sparks, of the city of Ottawa, capitalist; Alexander Lumsden, of the same place, contractor; S. Maynard Rogers, insurance agent, of the same place; John Inkerman MacCracken, of the same place, barrister at law; N. Hart White, of the city of New York, wholesale jeweller; Robt. Peel Wakeman, of Southport, in the State of Connecticut, capitalist; and Dwight Spencer Mason, of New York, lawyer.

The Determination of Sulpnur in Pyrites—A reliable method of estimating the quantity of sulphur in pyrites has been discovered by Mr. T. S. Gladding. First, grind the pyrites to an impalpable powder, dry at 100° C., and keep in well-corked bottles. Ten to fifteen minutes' drying is sufficient. Then weigh 1 gramme, introduce into beaker, cover with watch glass, and add 10 cubic centimetres bromine solution, mix by rotating beaker and allow to stand 10 minutes in the cold. Add 10 cubic centimetres nitric acid, mix as before, and allow to stand 10 minutes longer in the cold Finally, place the beaker on a water bath, containing cold water, heat slowly to boiling, and when solution becomes quiet remove glass after rinsing and evaporate to dryness. Add 10 cubic centimetres hydrochloric acid, keeping the beaker covered with a glass, and when violent action ceases, again remove the glass after rinsing, and evaporate to dryness once more. Add 1 cubic centimetre concentrated hydrochloric acid and 50 cubic centimetres hot water, digest until solution is complete, filter, wash with hot water. The filtrate, about 100 cub. centimetres, is now saturated with a slight excess of ammonia allowed to stand hot for 10 minutes. The precipitated ferric hydroxide is filtered and washed five or six times more on the paper with boiling hot water, the filtrate acidulated with hydrochloric acid in slight excess, heated to boiling, and 50 cubic centimetres barium chloride solution added, one drop per second to the boiling liquid. The solution is allowed to stand over night, filtered, washed, and ignited, the precipitate of ferric hydroxide is also dissolved in dilute hot hydrochloric acid heated to boiling, and 10 cubic centimetres barium chloride solution added. It is allowed to stand over night and the barium sulphate thus obtained added to the main precipitates. One filter paper can be used for the two precipitate. The bromine solution is prepared by dissolving 75 cubic centimetres of potassium bromide in 50 cubic centimetres water, adding 50 cubic centimetres bromine, stirring and adding water to 500 cubic centimetres. The bromine will nearly all dissolve. Another form of bromine solution used by some is made by saturating aqua regia with bromine. The first solution is the more certain, however, to oxidise all the ore without separation of any sulphur. The barium chloride is in 10 per cent. solution.

Miners' Changing and Wash Houses in Germany—The following description is given in a German periodical of the accommodation provided for miners at a Saarbrucken colliery: All the buildings are situated close to the shaft, and are so arranged that the miners are only exposed to the outside air for a short time. There is a large waiting room, which communicates on one side with the lamp room, and on the other with a refreshment bar, where coffee and bread can be obtained at moderate prices. Connected with this room is the changing and bath room, 108 by 64 feet, and 16½ feet high. The baths are cells fitted with a warm water douche, and the room contains in all 55 cells, each capable of holding two men. The walls of the cells are made of corrugated iron, and there is a wooden partition in front of the baths, shutting them off from the rest of the room. The room is also fitted with a few cold water douche baths. Between two rows of bath cells a railing is fixed to which ropes passing over pulleys near the ceiling are attached. There is a hook at one end of the rope on which the miner may hang his clothes and then pull them up to the top of the building. Each man has his own particular hook which is numbered. It is found that the clothes dry more quickly when pulled up into the warm air near the ceiling. The water is warmed by steam to a temperature of 95 degs. Fahr., and if the temperature sinks below this, the fact is notfied by the ringing of an automatic electric bell. Each bath requires about 7 gallons of water. The time allowed for the use of a bath for two men is five minutes. The present arrangements allow 1,200 workmen to bathe themselves in one hour. Out of 2,340 workmen 865 used the bath house regularly. The cost of the bath house was £2,144, or £39 per bath or cell. Special mine waggons are used for men meeting with an accident. These waggons are fitted with springs and cushions, and are made so as to go into the cage. The following articles are kept in a house close to the shaft for use in case of an explosion: (1) One small machine ventilator on wheels, and fitted with carrying bands; (2) 100 yards of zinc air pipes, with a few bends, hanging wire, and cloth for plugging holes; (3) rolls of brattice cloth; (4) saws, picks, hammers and nails; (5) three small hand ventilators; (6) 100 yards of small pipe for the hand ventilators; (7) water bottles and straps; (8) vinegar for filling the water bottles; (9) note books and pencils; (10) torch lamps for surface ligthing; (11) small pipes, screws, tools, etc., for ventilating and pumping requirements; (12) a portable fire engine with hose.

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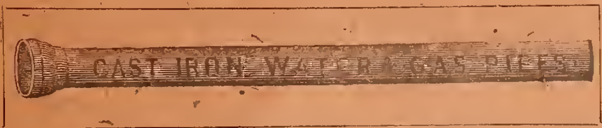
Cast Iron Pipes 

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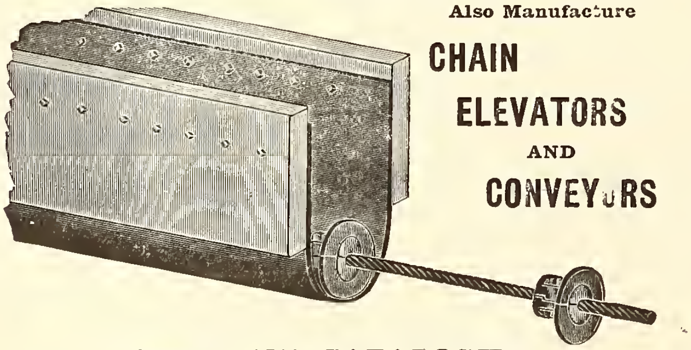

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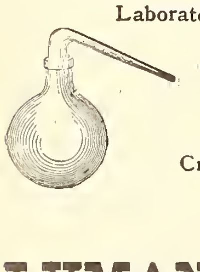

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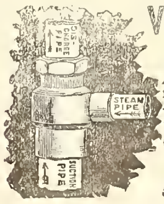

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VOL. XIV., No. 5 MAY, 1895. VOL. XIV,, No. 5

ONTARIO MINING INSTITUTE.

(Proceedings of April Meeting continued.)

The Rainy River Gold Fields, Ontario.

(Discussion on Mr. F. Hille's Paper.),

Dr. A. P. COLEMAN said Mr. Hille's was a very interesting paper, and, in general, it ran along the lines that he had himself found to be correct last summer. Mr. Hille had used the word "protogene," which was, perhaps, not familiar to some of those present. It signified a variety of granite in which the mica or hornblende had been changed into a talcose or chloritic mineral. The granites of which the writer had spoken, especially under the head of "protogene" were very interesting, because they form the country rock of the richest and most continuous veins that had been found in the district. They were true fissure veins. The fact that they radiate from large masses of rock generally called gabbro, but which is in reality anorthosite, leads to the conclusion that they are the result of volcanic disturbance at the time when these rocks were the basal or lower portions of what at the surface was given off as lava or volcanic ash. The Rainy Lake region had been examined since Dr. Lawson's time and since his own visit by two members of the Geological Survey staff of Minnesota, Messrs. Winchell and Grant, who have described it very fairly. Strange to say, they exactly reverse Lawson's account of the relationship of the rocks. Lawson supposes that the gabbro was the earlier of the two, and the granite a later eruption, while the two gentlemen named have taken the view that the granite was the earlier and the gabbro a later eruption. The evidence, so far as he (Dr. Coleman) had examined it, went to show that the later observers were correct. The gabbro does not show signs of having been subjected to any violent force, whereas the granite undoubtedly has. You find no veins in the gabbro, but you do find very well marked veins, and on a large scale, in the granite. An eruption of the gabbro burst the previously consolidated granites, and gave rise to the fissures that were afterwards filled by segregation or in some other way. The ore is somewhat refractory in its character. Mr. Hille has mentioned the chief sulphides that occur in it, and there is no doubt that in most cases the gold is carried very largely by the pyrites, and also to some extent by the other minerals. However, he could not agree with Mr. Hille's suggestion that some other mill than the stamp mill would be more suitable for treating the ore. It was his conviction that the great blunder in Ontario has usually been in getting some other mill than the stamp mill. His idea was that you ought to get a mill that really will work; but hitherto the method seems to have been to get the mill that least is known about. The results of this kind of management can be seen in the neighborhood of Rat Portage. He did not mean to say that those other mills would not work well in other regions or under special conditions in our own districts, but up to the present they have not worked well. He said: "Take the mill that has been proved to work." The first thing, however, that should be done in any mine was to prove that you have gold. He had strong objections to taking in a mill of any kind until a depth of a couple of hundred feet had been reached, and it had been proven that there was enough gold bearing quartz to pay for the mill. Up to the present only stamp mills had been introduced into the Seine river district. This, he thought, was wise. Most of them are small. One is a 10 stamp mill in the Shoal lake region, and two others are 5 stamp mills.

Mr. J. F. LATIMER inquired if the ores of the Rainy Lake region carried much sulphide.

Dr. COLEMAN—Yes, in several sections.

Mr. LATIMER—Any arsenic

Dr. COLEMAN—A little, not very much. Not enough to be any serious drawback. I may say that there is no district except that near Shoal Lake, where granite is the country rock; otherwise, the geological conditions are pretty uniform.

Mr. LATIMER—There are a few veins on Lake of the Woods, in granite.

Dr. COLEMAN—They are rather, I believe, in gneiss. The Bad mine, for instance, is between two layers that are probably both gneiss.

Gunpowder and Nitroglycerine.

By W. Hodgson Ellis, Toronto.

An explosive is a body which can, by a chemical reaction, suddenly develop a quantity of gas, large compared with the volume of the body before the reaction.

There are two ideas contained in this definition.

1st. An increase in volume due to chemical reaction.

2nd. The increase is sudden. The force of an explosion is measured not in foot pounds merely, but in foot pounds per second.

To illustrate, consider an analogous case. A cubic foot of water will yield about 1,700 cubic feet of steam. If this change takes place slowly as in a steam boiler under ordinary conditions, the expansion can be made to work, which can be regulated at pleasure—to grind flour, for instance.

If the change takes place instantaneously the boiler is shattered. This is an explosion, although water is not an explosive according to our definition; for the steam is formed from the water, not by a chemical action, but by a physical change merely.

Now, one explosive differs from another not only as to the nature of the chemical action which brings about the explosion, but also as to the rate at which this change takes place; and in studying the effects of a given explosive we have to attend to two things:—(1) The volume of gas which a given volume of the explosive yields; and (2) the rate at which this gas is developed.

Thirty years ago there was practically only one explosive—gunpowder (though many explosive substances were known). Today we have a fresh one patented every week, and it appears to be worth while considering to what causes the differences in the properties and efficiency of these bodies is due, and how far a knowledge of their chemical constitution can throw light on their behavior, and upon their suitability for different purposes.

There are two kinds of explosives:

1. Mixtures of two or more bodies which can be made to combine together, forming compounds which, under the conditions of the experiment, occupy a greater volume than the mixture.

2. Compounds which can be decomposed, yielding products which occupy more space than the compound.

As an example of the first class we will take a mixture of oxygen and hydrogen. As an example of the second class we will take chlorine monoxide, Cl_2O. Let us consider the second case first.

The equation representing the reaction is:

$$2\,Cl_2O = 2\,Cl_2 + O_2.$$

From this equation it follows that two volumes of chlorine monoxide yield two volumes of chlorine and one of oxygen, measured under the same conditions of temperature and pressure; that is, two volumes become three volumes, temperature and pressure remaining constant. But temperature does not remain constant. The decomposition of chlorine monoxide is attended by a disengagement of heat, and the heat so evolved is sufficient to raise the products of decomposition (supposing their specific heat to remain constant) from 0° to 1709° C. At this temperature 3 volumes of gas will become 22 volumes. This is therefore the space which two volumes of the original compound would occupy if it were free to expand. Hence 1 volume would become 11 volumes, or the gases produced by the decomposition would occupy 11 times the original volume of the compound. If now the reaction takes place in a closed space which prevents the gas from expanding at all, then the pressure increases in proportion to the volume the gas would occupy if free. So that in this case the pressure will be 11 atmospheres.

Let us now consider the first case. The reaction

$$2\,H_2 + O_2 = 2\,H_2O$$

is exactly the reverse of the one we have just been considering, and in it 3 volumes become 2 volumes—*i.e.*, if the temperature remained constant and the steam remained uncondensed, there would be a diminution in volume instead of an increase. But the temperature does not remain constant. In this reaction also heat is evolved and the quantity of heat is enough to raise the steam nearly 9,000° C. (if its specific heat remained the same). At this temperature 2 volumes would become 66. Hence the original 3 volumes would become 66, and one volume 22 volumes. That is, if the reaction took place in a closed space the pressure would be 22 atmospheres, or just double the former.

The importance of the part played by the heat disengaged in an explosive reaction is well brought out by these two examples.

To the first of the two classes that we have been considering belongs gunpowder. To the second nitro-glycerine.

It has been shown by the analyses of Bunsen, Karolyi and Abel and Noble, that the reactions which occur when gunpowder is fired vary with the composition of the powder and the conditions of the experiment and that the equation representing the explosion of military or sporting powder is a very complex one. In the case of blasting powder, however, of the composition of that examined by Sir F. Abel and Capham Noble, in their classical researches on the composition of fired gunpowder, we may deduce from their results the following equation:

$$4KNO_3 + 28 + 7C = K_2S_2 + K_2CO_3 + 3CO_2 + 3CO + 2N_2.$$

From this equation it follows that 552 grammes of gunpowder will yield 8 × 22327cc. = 178616cc. of gas, measured at 0°C and 760 mm. bar. Hence 1 gramme will yield 323cc. But since the heat evolved by the explosion of one gramme of gunpowder is about 500 calories, and since the specific heat of the products of the explosion may be roughly put at about ¼, the calculated temperature of explosion will be 2000°c. and the 323cc. will expand to 2689cc. One gramme of gunpowder occupies about 1cc. The sulphide and carbonate of potassium are liquid at this temperature and occupy about ½cc. Hence the pressure will be over 5,000 atmospheres or 40 tons to the square inch. Abel and Noble have found experimentally 42 tons to the square inch.

Saltpetre contains as much oxygen as 3,000 times its bulk of air, and gunpowder is merely a contrivance for burning carbon by means of this enormously compressed oxygen and forming carbon dioxide and carbon monoxide gases, while the nitrogen of the saltpetre is liberated at the same time.

The explosion of nitro-glycerine may be represented by the equation $4C_3H_5N_3O_9 = 1QCO_2 + 1O_2 + 6N_2 + O_2$, from which it follows that 1 gramme gives 713cc, and 1cc. (= 1.6 grammes) gives 1141cc., which is expanded by the heat evolved at least eight times, (Berthelot) probably more than this.

But the nature of this reaction is totally different from that which takes place in the explosion of gunpowder. That is a combustion propagated from particle to particle at a comparatively slow rate. The explosion of nitro-glycerine on the other hand is a detonation, a breaking up of the molecules propagated with a velocity comparable to that of sound—exceeding 5,000 feet per secono.

Six cubic inches of nitro-glycerine gives about a cubic yard of gas, requiring about $\frac{1}{10000}$ of a second for its formation, (Lewis.) A square yard of surface carries an atmospheric pressure of 9 tons, and this has to be lifted in the $\frac{1}{10000}$ of a second—*i.e.* more than one million foot tons per second. Figures such as these amply account for the well known shattering effect of nitro-glycerine, and for its destructive effects when tamped only by the superincumbent atmospheric air—effects which are commonly alluded to as the tendency of nitro-glycerine to "strike down."

It is a most important property of nitro-glycerine that this enormously energetic fashion is not the only way in which decomposition takes place. On being heated it first volatilizes slowly without decomposition. If the temperature is raised to its boiling point, which is somewhere near 180°C (350° Fahreuheit) it is converted into vapour with much rapidity and the vaporization is attended by partial decomposition. It may be set on fire and will burn quietly away because the heat is carried away by the gaseous products before it has time to be communicated to the rest of the nitro-glycerine. But if the temperature of any of the nitro-glycerine be raised to a little above this temperature (180°C—350°F) the decomposition takes on the character of detonation and is propagated as such through the whole mass and even to neighboring masses.

The importance of these facts on the practical employment of nitro-glycerine, and especially upon the thawing of dynamite cartridges need only be alluded to.

Underground Photography.

By Mickle & Evans, Mining Engineers, Sudbury.

Underground photography is a subject which has received a considerable amount of attention during the last few years. Mr. Burrow, of Cornwall, deserves especial credit for the patience he has exercised in his efforts to take good photos underground, and he has been rewarded by obtaining some excellent photographs. For obtaining sufficient light, he found after a great number of experiments, that it was necessary to use two lime lights in addition to flash lights, but even with all these appliances for giving light, only a small number of his trials were successful (about $\frac{1}{8}$).

We will show some slides obtained from photographs which we took in some of the nickel mines near Sudbury. In taking these photos we used magnesium powder only, as the use of limelights would be so troublesome and expensive as to be out of the question for most people. We made altogether about 70 trials, using different plates and lights, and obtained 7 or 8 good photos, and about the same number of passable ones, the rest were total failures. The chief difficulty appeared to be to obtain enough light to illuminate the large spaces, in addition to this the air was saturated with moisture aud foggy, and generally smoky, either from the miners' lamps or blasting powder. We soon found that it was useless to attempt taking any photos where the miners had been working for any time, the only time at which anything could be done was early on Monday morning before the men went to work. Even then the air was too foggy some days to get good results. It was, moreover, possible to take only one photo in the same stope on the same day, (unless the ventilation is very good), as the smoke from the large quantity of magnesium powder used soon obscured everything. In all our trials the same camera was used, viz: a 5" x 7" Hawkeye folding camera. We got good results with Stanley plates sent, No. 50, and Cramer Crown.

We tried small flash lamps and magnesium ribbon, but found they were altogether inadequate, and it was not till we used two continuous blast flash lamps holding 120 grains of magnesium powder each, that we got any satisfaction at all; the powder in the lamp is blown through a flame of burning alcohol, and the blast lasts about half a minute. One lamp was generally held behind the camera and another off to one side, but of course not directly in view of the camera, by this means we were able to show a man in one case 150 ft. from the camera, one light was let off near the man but sheltered from the camera behind a rock. As the result of our experiments so far, it appears to be necessary in order to secure good results, to select a day on which the air is not foggy or smoky in the mine, to use only the most sensitive plates, to have some background which will reflect the light more or less, and not to face the camera towards very large stopes, if the stopes are more than about 50 ft. wide it does not appear to be possible to show the opposite wall clearly, and if there are any miners in the picture, they should not have their lamps in their hats as the flame only makes a blur and spoils their faces.

When these conditions are observed very fair results can be obtained by use of magnesium powder only.

Heinrich Boarner (a photographer in Freiberg) has also published some excellent photos taken in the mines near Freiberg, by magnesium flash light.

Does the Vibration of Stamp-Stems Change Their Molecular Structure?*

E. E. OLCOTT, New York City—I am sorry that I have not followed carefully the various contributions that have been made on this subject. I have been much surprised to hear the statements of Dr. Raymond, and regret to be obliged to quote my own experience in opposition to them; but I am very strongly of the opinion, from numerous observations, that some change occurs in iron as a consequence of frequent vibration. The place where I have seen examples of it so often is in the breaking off of the stamp-stems that has been alluded to. It is no uncommon thing to see around stamp-mills, even now, a number of short ends of the stems, broken off just above the boss or stamp-head, the crystalline faces on which are as distinct as in a broken pig of cast-iron. I have also seen these stems, after having been used, first at one end and then at the other, cut in two in the blacksmith's shop, at places away from the boss, where they show a perfectly fibrous structure. Now, I think that the stamp-mill mortar is an ideal apparatus for causing great vibration at one particular point; and I should say that the numerous occurrences of the iron breaking in that way and the frequent observation of crystallization furnish, perhaps, a stronger argument in favor of the phenomenon than the experiments made by imitating for a short time the strains that the stamp-stems sustain. It is a subject that I will try and investigate a little further. As I say, I have no wish to oppose my observation, perhaps prejudiced by the practical mill-men, to the eminent authorities that have been quoted.†

WILLIAM KENT, Passaic, N.J.—I have been reading up on this subject for nearly twenty years. I saw the porter-bar mentioned by Dr. Raymond in 1875, shortly after it was broken, and everybody who saw it then thought it was an unmistakable evidence of crystallization. In earlier times the belief in crystallization was almost universal. Afterwards people began to differ on the subject, and there were opinions expressed on both sides. In 1879, in a paper "On an Apparatus for Testing the Resistance of Metals to Repeated Shocks" (*Trans.*, viii., 76), I think I was a little on the fence, though rather a little over on the side of the crystallization theory. Now, I have read whatever I have come across on that subject in the last fifteen years, including Dr. Raymond's paper, which I received the other day, and I am still not satisfied and am strongly inclined to believe with the gentleman (Mr. Olcott) who has just spoken. There is no higher authority than Bauschinger, who has recently died; and Prof. A. Ledebur quotes him as saying: "Strains of iron and steel repeated frequently, millions of times, bring about no change of structure."

That statement seems to me most astonishing when it is well known that you can take a bar of iron or steel and, after it has been subjected for years to shock and vibration, to all appearance there is no change in the piece of metal; yet, if you test it, you will find that it is more brittle; and some day that piece breaks. You may not find the evidence of cubical crystallization, but it always breaks with that appearance which we call crystallization. Now, can we say that that piece has been stading all this shock and vibration and has finally broken without molecular disintegration having taken place until just before it broke? Can we say that that piecc has experienced no change of structure? I remember that at one of our meetings we were shown some pig-iron that was very hard to break; it took about four hundred blows of a sledge to break it, and yet finally it did break with a single blow. The same way with wrought iron and steel. It resists shock a long time, then breaks. Something has happened to it. It may not be crystallization. I do not hold that iron once fibrous becomes crystallized; but to say that there is no molecular change is, I think, going too far. The statements made about Wöhler's experiments proving anything about crystallization do not, in my opinion, prove anything at all; because in his experiments there were repeated steady loads placed on gently, and they were not shocks at all. In the paper that I presented fifteen years ago, and to which I have referred, I pointed out that no scientific experiments on the resistance of steel to shock had been carried on, and gave a design for a machine to test this point. I am very sorry that it has not as yet been built. If it were built, I think it would settle this matter of crystallization. The statements made during the last ten to fifteen years about what has been proved, or alleged to be proved, amount to nothing; and I claim that the statements that no crystallization happens are all theories and not deductions from actual experiments. If we can get a translation of Bauschinger's experiments, it would be very important; but I do not think he would go so far as to say there was no molecular change. He says that no change of structure took place; but the expression "no change of structure" is commonly broadened so as to cover every possible kind of molecular change. It may be all right to say that crystallization does not happen, or to say that there is no crystallization which has been determined by the naked eye or by the microscope, or that nothing happens so far as we can see; but as long as pieces of iron, after long service, do break with ordinary loads when they are apparently just as when they were new, we must believe that during this long service something happened to the iron which weakens it, which something is equally dangerous whether we call it crystallization, change of structure, molecular change or molecular disintegration.

JOHN WILKES, Charlotte, N.C.—As a builder and user of stamp-mills for the last twenty-five years, I have to differ in regard to the effect stated here. I do not go into any theories at all, because I have none; but my experience has been that a change certainly takes place in a stamp-rod near the boss or head. Some time ago the custom was to upset or cut in two after the ends broke off, and weld together in the middle. Those stamp-rods we found broke again in the middle, away from the weld, where the iron had been worked in the forge-fire. Now, stamp-users in my section of the country only change the ends. The ends break clearly. When millers were not careful in regard to their work, the stamp-rods broke in a very short time, sometimes in six months; but with greater care, now, the life of the stem is about two years and a half.

Vice-President J. F. HOLLOWAY, New York City (in the chair)—By changing the ends you mean reversing the rods and putting the head on the other end?

Mr. WILKES—Yes, sir. Without an exception, all broken ends show a granular crystallized appearance. Some of them I have seen show a granular structure as large and as perfect as in Scotch pig. That they did present a granular effect is without doubt, and it continued above the break, as these rods, when upset, did not break in the weld, but within a foot, more or less, of the portion of the iron which had been again worked in the forge. During this discussion, and since the paper was read in Chicago, I have taken pains to examine rods which have been sent to us to be turned over. Within the last three weeks, rods have been sent to us that had been in use three years. One of them had quite large crystals, such as you would see in Scotch pig-iron. It was my intention to have brought one of those stamp-ends here, as it would have shown the members of the Institute that the fact remains, whatever the theory may be. If there is any place where this question of vibration can be brought up and looked into, it is in a stamp-mill. Think of a weight of some 750 to 800 pounds dropping eighty times a minute for days and months. If granulation or crystallization would take place anywhere, it certainly would be there. I am not a theorist myself. I accept the explosion of the crystallization theory. At the same time, in a stamp-rod, the fact of granulation or crystallization does exist without any doubt. Within the last year we have begun to substitute steel instead of iron, but with what effect I am not as yet able to say. We find that in mills that are properly taken care of, so that the vibration is reduced as much as possible, rods have a longer term of life. Packing the end of the rod with cloth before it is driven into the boss-head will increase the life of the rod. Scientific men, to whom I listen with a very great deal of interest, may be able to tell whether steel will stand this vibration better than iron or not. We have found that the use of steel in other parts of the stamp-mill where the vibration comes has proved advantageous.

Mr. HOLLOWAY—I would like to ask Mr. Wilkes whether it has ever been the practice of people using stamps to take these stamp-rods out at intervals and reheat them in a wood-fire?

Mr. WILKES—I do not know of anything of the kind having been done. As a user of stamp-rods, as well as a maker, I question whether a wood-fire would do away with this granulation, which certainly does exist after some years' use.

Dr. RAYMOND—Is there any notable tendency on the part of stamps in the south—with which section of the country Mr. Wilkes is more particularly acquainted—to break just under the tappets?

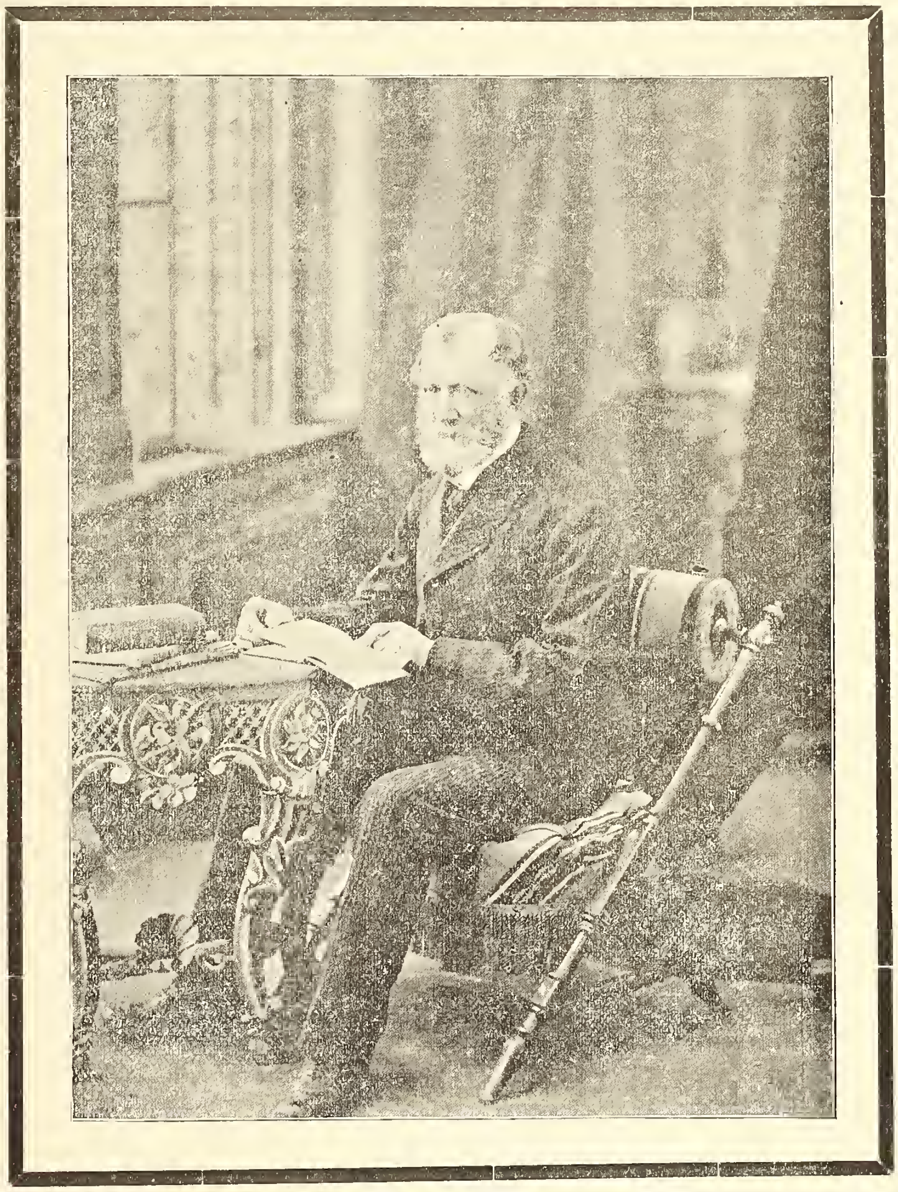
Mr. WILKES—I do not know of any breakage of that kind. The breakage is just in the edge of the box or the head.

WILLIAM R. WEBSTER, Philadelphia, Pa.—I would like to ask Mr. Wilkes if the boss on the rod is put on by upsetting?

Mr. WILKES—No; it is only where a rod is broken that we upset it. We use

* A continuation of the Discussion arising in connection with Mr. Rickard's paper on "The Limitations of the Gold Stamp-Mill."—(Transactions of the American Institute of Mining Engineers, xxiii., p. 574.)

† See Mr. Olcott's later communication to the Secretary on a subsequent page.



THE LATE W. H. JEFFREY, RICHMOND, QUE.,
(Of the Jeffrey Asbestos Mine).

the best refined iron. The rods are turned up, and then tapered in the lathe to the taper of the head, the end of the rod being made a little smaller than the rest of it. Both ends are tapered. The mortice in the head is tapered, and the stamp-rod is driven in ; it only requires one or two blows to make it tight. In all the fractures I have never observed one that extended out of the level above the boss-head an eighth of an inch. It is as if it had been cut off with a knife.

MR. HOLLOWAY—It is the practice of lumbermen, I know, to take their log-chains and throw them on a log fire and heat them up at regular intervals ; and it has been found from experience that the life of a log-chain is very much prolonged by doing that.

MR. WILKES—I should think that might be a good thing to do. At the same time, the use of a log-chain is very different from the vibrations of a stamp-rod. I know of no place where the vibration is so great as in a stamp-rod, particularly in a mill that is not taken care of properly.

ALBERT R. LEDOUX, New York City—It may be interesting to put on record an experiment which I made that confirms very strongly the statements in the authorities, that even the best wrought-iron will break under certain circumstances with the fracture of cast-iron. A few years ago a steamship broke her shaft just at the point where the crank-arm joined the sha t. It was forged on. Under the Admiralty law, the case having come up in the United States Court, it was held that if that shaft broke from a flaw within it, although the owner of the vessel could not possibly have ascertained that the flaw was there, yet he was liable for the loss of the cargo—which happened to be fruits from the West Indies. If, on the other hand, the break was caused by the stress of weather, then the loss would fall on the insurance company. It was, therefore, an important matter to show why the shaft broke. I was an expert witness in the case, and had opposed to me an eminent marine engineer. He examined the fracture of the shaft, and testified that it was undoubtedly due to the poor quality of the iron ; that the fracture was granulated ; and that the granulation was not due to age, but to the fact that the shaft was poor in the beginning. I simply placed in evidence Kirkaldy's work, and called attention to the fact that there might have been a sudden strain upon the shaft, and, if so, according to Kirkaldy, it might break with crystalline fracture. In order to test this theory of Kirkaldy's, I went to the Rogers locomotive works and asked them to give me one of their best wrought-iron car-axles. This axle we broke on an anvil by means of a steam-hammer, bending it back and forth until it was broken with fibres as long as your finger. It was a new axle. We then laid one-half of the axle, with the fibrous end on the anvil, and tapped it gently until we had straightened it. Then the piece was placed between two rather narrow supports, and the full force of the hammer was allowed to strike it with a blow of many tons. It suddenly broke, and I had a piece six inches long, one end of which was beautifully fibrous and the other end showed coarse crystals. That piece we took into court and established our case.

R. P. ROTHWELL, New York City—I think there can be no question among those who have used iron and steel under such conditions as have been described that there is a molecular change under certain circumstances. Whether that change is due altogether to shock or not is, perhaps, an open question. At least, the same effect seems to be obtainable by different means. At one time I was using a very soft steel wire rope. It was too soft for ordinary use. We were using it on a slope, and the lower end of it would become highly crystalline. Periodically we would have to cut off six or eight feet of it. The wire before its crystallization (and I call it crystallization for convenience) was extremely tough. You could twist it round and round many times without breaking it ; and when it did finally break it showed the finest silky texture. But where it broke at the end of the rope in use, it appeared under a magnifying glass as if the carbon of the steel had collected into flakes of graphite running across the structure of the steel, and it had broken through these graphite structures. We attributed this effect to the acid waters of the mine. It was a coal-mine, and the rope would get wet at the foot of the slope. Now, a stamp-stem is sprinkled constantly with water, and that water is very likely to be more or less acid. It may be admitted freshly, yet still it is almost always in contact with pyrites in the ore. I merely suggest whether there may not possibly be some such action as that which we observed with the steel wire rope ?

MR. HOLLOWAY—Is it not true that at the bottom of the slope there would be a little slack at the end of the rope, and that in taking up the slack the tension would come suddenly on that end of the rope ?

MR. ROTHWELL—Yes, to a certain extent. It would not be sudden, however. With a wire rope 500 or 600 feet in length there is so much spring that you would get no sudden jar—nothing that you could fairly look to as a cause for crystallization in the wire.

MR. WILKES—There is no question in my mind but that mine water will have an effect in the way Mr. Rothwell described. In the South, however, miners do not use mine-water in their stamp mills, if it is possible to get surface-water, on account of its effect on amalgamation. Therefore, the water we use could not have much effect on the iron.

JOSEPH C. PLATT, Waterford, N.Y.—This discussion brings up some reminiscences of the time when I was a young man and employed in puddling. I remember distinctly breaking puddling-tools, the ends of which were about seven-eights of an inch in diameter, with a hammer weighing not over four pounds, when striking the tool a blow only sufficient to jar off the cinders. It was a blow which would not have probably driven a ten-penny nail half an inch into a plank, and yet it broke the bay in a manner that would indicate that something was wrong with the iron. These handles were used probably for 25 years. The end that was put into the furnace was, of cource, renewed frequently. When a tool became hot it was pulled out and another put in, and it was simply subjected to the jar of the puddle-bar on the front-plate under the notch. It was a very common occurence for the handle to break off under a blow such as I have stated. It seemed to me a very strange thing that iron which had lasted for years would suddenly break in that manner.

A MEMBER—It was at blue heat, probably.

MR. PLATT—No ; that end of the tool did not get very hot. That was the cold end.

W. F. DURFEE, West Brighton, Staten Island, N. Y.—In a lecture delivered May 11, 1887, at Annapolis, Md., before the United States Naval Institute (See Trans., U. S. Naval Institute, vol. xiii., No 3 pages 369-376), I discussed this question at considerable length, and the following statement, condensed from that lecture, expresses my view to-day as completely as it did eight years ago. The portions omitted in this abridgement were in the nature of explanatory repetitions and illustrations, adapted to a popular audience, but not necessary here :

Wrought-iron is realy a mechanical mixture consisting, at its best, of clusters of crystals (which may with propriety be regarded as compound crystals) of iron, separated from each other by films or threads of cinder, as the unavoidable result of the process of manufacture. When the puddler's balls are squeezed or hammered, for the purpose of expelling the cynder and welding the granules or crystals of iron into a homogeneous mass, the attempt is never wholly successful ; for the cinder, as the metal cools, quickly becomes pasty and flows with difficulty, so that portions of it, inclosed in the interior cavities of the ball, are simply flattened out or elongated, but not removed. Hence the bloom is a complete mass of granules or crystals of iron, separated from each other by films or strings of cinder of very irregular dimensions.

By crystals of iron I mean ultimate units of that metal bounded by well-defined planes whose intersections always form salient angles. A number of such crystals may cohere and form an aggregation, and such aggregations, or compound crystals vary in size, and are often spoken of as single crystals, just as we speak of crystals of galena or calc-spar, when as a matter of fact, the ultimate crystal of each of these substances remains undiscovered, and as undiscouverable as the boundaries of space.

In forging a bar it is the usual practice to turn it about its axis through en angle of 90° between the blows (or series of blows) of the hammer and in rolling a bar it is commonly turned through the same angle between passes through the rolls. Consequently, when a bloom is rolled or forged into a bar the metal is acted upon in two directions, at right-angles to each other, and its compound crystals will be compressed in directions normal to the exterior surface of the bar and at the same time extended in the direction of its length. Thus the ends of adjacent crystals are forced toward each other, and the intervening cinder, endeavoring to escape is compelled to move at right angles to the axis of the bar and to unite with the films or threads of cinder which have become established in parallel lines of llast resistance along the flanks of the compound crystals and at right angles to the direction of the force upon the bar.

The direct consequence of the elongation of the compound crystals and the effort of the intervening cinder to escape in the direction of least resistance is the establishment of that structural peculiarity in the resulting bar known as " fiber, " which is a conspicuous feature of wrought-iron not found in any other variety of ferruginous material. When any of the films or threads of cinder in a bar of wrought-iron are so large as to be distinctly visible on its surface to the unassisted eye they are called " sand-seams " or " cinder cracks. "

If its compound crystals are merely pure iron, the bar can be readily bent cold without fracture, and, if pulled asunder by a gradually augmented orce, its fibrous texture is at once evident ; but in case the compound crystals contain in chemical combinatian some substances, such as phosphorus or silicon, which tend to diminish both the cohesive attraction between crystals and the mutual attraction of the compound crystals, then the bar cannot be easily bent cold without rupture, and exhibits, when broken, a so-called " crystalline fracture." Notwithstanding this appearance, however, the mechanical structure of the bar is the same as before, that is to say, the cinder and the elongated compound crystals are still arranged in lines parallel with the axis of the bar, although it is quite probable that the average length of the compound crystals may not be much less than in the case of a bar of purer iron.

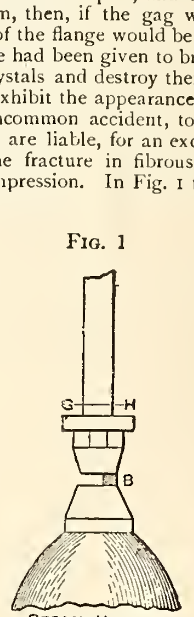
Whenever a bloom is subjected to a force of compression always acting perpendicularly to the same plane, as is the case when it is rolled into a a sheet or plate, both its compound crystals and the accompanying cinder are flattened and extended parallel with that plane, and the resulting sheet or plate has more of a laminated than a fibrous structure, being built up of a number of leaves or strata of iron, separated from each other by films of cinder, which, when unduly thick at any point, cause defects in the plate that are called " blisters. "

Can a bar of wrought-iron of a pronounced fibrous structurc be ruptured so as to exhibit a crystalline fracture ? I answer, Yes, in two ways : first, by a sudden application of a force of extension commonly called a " jerk ; " second, by a prolonged repetetion of a force of compression, sometimes called a " jar. "

The first method of rupture may be said to consist of a transverse separation of the compound crystals of the bar, as distinguished from a sliding of their interlocking flanks upon each other, as is the case when the rupture presents a fibrous appearance. I have often seen crystalline fractures produced in truly fibrous iron. In the manufacture of iron rails (now nearly an extinct industry), it was always considered desirable that they should be of a hard and crystalline texture as to their heads, but soft and fibrous in their flanges ; but, however perfectly this distribution of metal was made, it was always possible to break a rail so as to show a crystalline fracture in its flange. This was accomplished by making a slight nick across the flange (to determine the point of fracture), and placing the rail (flange down), in the straightening press, on supports placed a short distance on either side of the nick and then putting in the gag " heavy " just over it : the result was almost always a crystalline fracture in the flange ; in short, the elongated compound crystals were jerked asunder. But if the points supporting the rail were placed farther apart, and the rail given an opportunity to yield considerably between them, then, if the gag was put in " light " a number of times in succession, the fracture of the flange would be sure to exhibit a fibrous texture, due to the fact that sufficient time had been given to break up the films of cinder along the flanks of the compound crystals and destroy their transverse cohesion, thus permitting them to slide apart and exhibit the appearance of disrupted fibres.

We are indebted to a not uncommon accident, to which the hammer bars of a peculiar type of steam hammer are liable, for an excellent illustration of the second method of producing a crystalline fracture in fibrous iron, the result of the repeated action of a percussive force of compression. In Fig. 1 the bar of such a steam hammer

FIG. 1



STEAM-HAMMER

is represented. As has been stated, there exist, in a bar of fibrous iron, films of cinder between the ends of its elongated compound crystals. These, from the nature of their formative process, cannot possibly be of uniform thickness. This, considered in connection with the fact that the greatest force of the percussive action per unit of area of any cross section of the hammer bar is exerted upon a section made by a plane cutting the bar at right angles immediately above its head, justifies the belief that at or near this point fracture would be most likely to occur. It is also evident that the percussive action of the hammer would have more destructive effect upon the thick than upon thin films of cinder ; while, at the same time, the force of cohesion between the ends of adjacent compound crystals will be diminished in some inverse proportion to the thickness of the films of cinder between them. It therefore seems exceedingly probable that the fracture due to continued percussion will take place, if not in the plane above named, yet in one very near to it, in which the cinder films chance to be of greater thickness than those in that plane, and, as a matter of fact, fractures in such bars are usually within a few inches of the point where the bar enters its head, as at G-H, Fig. 1.

The particular point in the circumference of such a hammer bar where the imminent fracture first appears is often determined by the manual peculiarity of the "hammer-man.' A left-handed man will incline his work to the left, and a man who is right-handed will be likely to use the right side of the anvil more than the left. In the latter case, the work B, Fig. 1, will tend (whenever it is in the position shown), to produce a tensile strain at the point G, which, as the work is shifted to the center or occasionally to the left side of the anvil, becomes a compressive strain. We should, therefore, expect (as is, in fact, the case), that the initial manifestation of the fracture would be found at that point, and that it would gradually extend towards H, until the bar was finally "jarred" asunder. The separation would take place through films of cinder between the ends of the elongated compound crystals of the bar, thus exposing those ends, and exhibiting what is called a crystalline fracture.

The belief in the so-called crystallization of wrought iron, as the result of prolonged use, is, I think, altogether a mistake; and I am clearly of the opinion that the crystallization observed in the case of any particular fracture existed, just as we see it, at the time the metal was given the shape in which it was ruptured. After a bar of distinctly fibrous wrought iron has been subjected to multitudes of sudden jerke of extension or jars of percussive compression, the cinder in some cross section of it (in which this impurity is slightly thicker than elsewhere), gets broken up, cohesion is destroyed, and the bar breaks with a crystalline fracture.

I have had a specimen prepared for the purpose of making the foregoing explanation of the apparent crystallization of fibrous iron more evident. It is a short piece of square bar of wrought iron. One end is decidedly crystalline in its fracture, showing distinctly that the bar was originally built up of five flat bars. The other end is, for more than one half of its area, as decidedly fibrous as wrought iron can well be; and this end would have been uniformly fibrous in appearance had the workman who made the specimen exercised the requisite care. Thus, in a sample not over two inches in length, we have an instance of a fracture which most observers would call very bad, and another which as certainly would be called good.

It is a well known fact that wrought iron is improved in strength by repeated working. This may be accounted for thus: In the initial heating and shaping of the metal, its crystals were left with a comparatively thick film of cinder between them; but by each successive re-working, the crystals of metal are driven into closer order, some of the intervening cinder is expelled, and what remains is very much reduced in thickness, so that the cohesive attraction (whatever that may be) between these crystals, having less space to act through, acts with augmented intensity. It is well to remember when we speak of "less space" in a matter of this kind, that we are dealing with a very small quantity indeed—one that is a near neighbour to the infinitesimal.

W. H. SHOCKLEY, San Francisco, Cal.—With regard to the use of mine water in the battery, the custom on the Pacific coast is the same as Mr. Wilkes states it to be in North Carolina. Mine water is not used in the battery when it can be avoided.

I do not think the water causes the stamps to break, as suggested by Mr. Rothwell; for they last longer in a wet-crushing mill than they do in a dry-crushing one, where no water at all is used.

From my own observation, I do not think the vibration causes the stamp-stems to crystallize and hence to break. The chief strain on a stamp-stem is a bending-strain, caused by pieces of rock tilting the stamp when struck by the circumference of the shoe. This gives a strain, nearly all the effect of which is concentrated at the place where the stem enters the boss; and it usually breaks at this place. I have noticed on shafts that have been broken flattened places on the fractured surface, showing that the bending caused enough motion to wear the surfaces smooth.

The pieces of metal mentioned by Dr. Ledoux and Mr. Durfee prove conclusively that the appearance of the fracture does not show what the internal structure of the metal was before it was broken.

If the vibration causes stamp-stems to crystallize and break, it certainly requires a very long time to produce that effect; for I have known stamps to be in use for four years, dropping 95 times per minute throughout that period, which would give something over 200,000,000 blows.

As a matter of interest, however, I remark that all the blacksmiths and manual workers of iron with whom I have talked believe that iron will crystallize under shock.

MR. WEBSTER—Some years ago, an inspector of bridge-material, after making thorough tests of double-refined iron bars for eye-bars, was so well satisfied with the tension-, bending- and nicking-tests that he made a special report to the rolling-mill, saying that it was the best material he had ever inspected. After these bars had been manufactured and shipped to the mill-site, a test of the full-sized bars was received, which showed very poor results, the bars having been broken through the head and in the neck with bad crystalline fractures and low ultimate strength. The bars were all condemned and taken out of the structure. A thorough investigation was made of this material by nicking tests, starting in the centre of the bar and going towards the end; and in all cases good results were obtained from the body of the bar, and crystalline fractures in the neck. Bending-tests without nicking showed the same difference. In many cases the bars did not bend 10 degrees in the neck, but even at the first stroke or two of the small hydraulic jack that we were using, the sharp, snapping sounds were heard and the material gave way all at once. The crystals were very large. Additional tension-tests of the full-sized bars were made, and some of them broke in the neck with as low an ultimate strength as 42,000 pounds per square inch, the fractures being all crystalline. Had these bars been in use several years, when this trouble was discovered, it no doubt would have been cited as another instance of crystallization of the material, caused by the vibration.

I cite this to show the importance of knowing the heat-treatment to which iron has been subjected before we attempt to theorize on the change of structure due to vibration.

In 1884, Mr. Peck, superintendent of bridges for the Missouri Pacific Railroad Company, called my attention to the fracture of some eye-bars, taken from the wreck of one of their bridges, which had been knocked down by a derailed train. These bars, he claimed, were made from good material by one of the leading bridge companies of the country, and yet they broke off short like pot-metal. Upon thoroughly investigating, we found that the bars had broken through the neck, with a coarse, crystalline fracture. I called his attention to the trouble often caused in that portion of the bar in the course of manufacture; and he embodied in his new specifications a clause which called for "eye-bars to withstand bending to a curve of 90 degrees in the neck." This test was carried out by subjecting to a welding-heat a piece of the bar about 16 inches long, allowing it to cool slowly without putting work upon it, and then bending it under a press. Several lots of material were condemned as not meeting this test.

In 1881, while we were making bending-tests of double-refined bar-iron under a small hydraulic press, the work was interrupted after several pieces had been bent about 170 degrees over a 2-inch round. Twelve hours afterwards, these pieces were put on end under the hydraulic press and we attempted to close them down further. Much to our surprise, they broke off short, the fracture being 100 per cent. granular. At first it was thought that the cold might have had something to do with this, as it was in the winter season and the pieces had been left out over night; but upon repeating the experiment and keeping the pieces indoors all night, at a temperature of about 70° Fahr., we got the same short fractures as obtained before. The same bars, when broken in the ordinary way, that is, without any interruption of the test, gave fibrous fractures and were satisfactory in every respect. This experiment was repeated on different sizes and makes of iron; and sometimes the fracture was changed and sometimes not. (I refer to the fractures as granular, as they were entirely different from the crystalline fractures cited above as being produced by the heating of the bars.) It would be interesting to follow up a set of experiments on this line and carefully note all the conditions, including chemical composition, in order to get at the cause of this apparent change of structure.

I believe I have still a piece of one of these bars, about four inches long, one end of which is entirely granular and the other end fibrous.

DR. RAYMOND—On page 12 of the pamphlet discussion of this subject already issued, in the last paragraph but one, allusion is made to the photograph of the broken connecting-bar of the Washington navy-yard, as showing "the laminated structure due to rolling." As the bar was made under the hammer, I should have written "forging." This error will be corrected in the *Transactions*.

This discussion illustrates forcibly the importance of attaching definite meaning to the terms employed in describing observed facts. "Molecular change" and similar phrases—even "change of structure"—may be (and, I fancy, have been, in this discussion) employed as signifying no more than incipient fracture, or the progressive separation of the units of structure in the line of stress, or the gradual diminution of tensile strength under repeated stresses. Strictly speaking, not one of these phenomena necessarily involves *molecular* change, such as is involved in the re-arrangement of the molecules, to form crystals. That they do indicate, in a certain sense, a structural change, is not denied. But this change may be the same in kind as that produced by any kind of fracture. When any two continuous elements of structure are pulled apart, whether gently or violently, gradually or suddenly, there is a change of structure, if we choose to call it so. But it is useless to confound that change with one that is supposed to take place prior to any rupture between the elements. When Mr. Kent speaks of "molecular disintegration," I understand him to mean a loosening of the existing structure, not the formation of a new one; and, in that sense, I conceive that he is stating exactly the position assumed by modern investigators, who fail to find any proof of a radical change of structure preceding fracture.

Mr. Kent does "not hold that iron once fibrous becomes crystallized," yet declares that "the statements that no crystallization happens are all theories." I must repeat my protest on the latter point. The advocates of the crystallization-theory have no right to call simple disbelief in this proposition a "theory." It is incumbent on them to prove their position; they cannot demand that doubters should prove a negative. As to the only theory here under discussion, it is perhaps not fairly represented by the proposition that "iron once fibrous becomes crystallized." If that be the theory, then it suffers under a double lack of proof; for there is no evidence that any iron is fibrous prior to rupture. We produce a fibrous or a non-fibrous fracture at will, according to the method of breaking.

Mr. Durfee's explanation of the process of fracture in wrought-iron seems to me to satisfy the observed facts, although I do not think that the presence of films of cinder between the elements of structure is absolutely necessary to an explanation. Planes of small cohesion might suffice. What Mr. Durfee has pointed out concerning the breaking of steam-hammers is, to my mind, pertinent and conclusive; and I deem it highly significant that he has directly observed, in such cases, incipient fracture.

It seems to me also significant that Mr. Wilkes's stamp-stems break only just above the head and not under the tappet, while Mr. Austin reports that in western mills the stamps break in both places. I am inclined to infer that the North Carolina arrangement of tappets and cams is superior; and I may go further and say that possibly some better connection between stem and head might reduce the amount of breakage in both types of mills. I venture to believe that if a stamp were composed, for instance, of one solid cylinder of iron, of equal diameter throughout, there would be no sign of "crystallization" in it if it ran fifty years. In other words, I think there is no proof of an inevitable destruction of the material, by the operation of a universal law, which cannot be largely prevented by strengthening the parts now exposed, without special protection to nicking- and bending-strains.

In this connection I would call attention to two very able and thorough articles by Mr. Paul Kreuzpointner, of Altoona, Pa., entitled, "Do Iron and Steel Crystallize in Service?" and published in the *Iron Age* of July 5th and September 27, 1894. Mr. Kreuspointner is the accomplished assistant of Dr. Dudley in the Altoona laboratory of the Pennsylvania Railroad Co. His discussion of this subject ought to convince any one who still inclines to the "crystallization theory" of the baseless and untenable character of that theory. I will quote but one sentence from his second article, which gives a new reason for disputing the traditional error. He says:

"It would hardly be worth while to take the old superstition about the crystallization of iron under shock seriously at this late day, if it were not for the fact that this superstition is being transferred to steel. This is really a misfortune to the constructing engineer who may happen to believe in it, and to the consumer of steel in general."

MR. WILKES—Referring to what Dr. Raymond has said concerning breakage under the tappet, I have no doubt that the best shapes for cams and tappets should be used, so that, when the lift begins, the blow may be as light as possible, and the friction between cam and tappet during the whole lift to be as small as possible. This shape we have secured in our practice by adopting true curves at first, and modifying them as observation of their behavior in actual work suggested. While we were using iron, we succeeded in this way in reducing vibration, wear and tear to a minimum. Since we have adopted steel for the parts referred to, a great further reduction in wear and breakage has been secured, as the result, in my opinion, of the retention of the original form of the cams and tappets, and consequently, the more certain keeping of the stem in its proper place during the lift. This permits a fairer blow, and more effective work. The stamp mill is often regarded as a rough machine that can be taken care of by anybody. But it needs, like any other machine, to be kept in order, if it is to do good work. Suitable care bestowed upon it will effect improved results as important as those to be got from any other kind of machinery used about a mine. A properly constructed and properly handled stamp mill is, by reason of its simplicity and its economy in metal consumed per ton crushed, still the favorite appliance for reducing ores for amalgamation and concentration.

MR. OLCOTT (later communication to the Secretary)—The result of a little study on the subject shows the weight of scientific argument to be against the crystallization of iron from shock or vibration at ordinary temperature. I have read the two able articles on the subject by Mr. Kreuzpointner, to which Dr. Raymond has called attention. The salient points of these papers, as affecting the stamp stem discussion, seem to be:—

1. That the crystalline appearance on the fracture is caused by the manner of breaking. That is, where fibers are broken transversely they show granular or crystal-

line faces, but where pulled apart longitudinally, the same iron shows a fibrous structure. In other words, the stamp stem may have been weakened and finally broken off by successive shocks, and short kinks or bends, operating transversely, as the result of striking uneven surfaces in the mortar, etc.

2. The iron in a bar may be crystalling at one point, but fibrous at another.

3. Iron may have been crystalline at the point tested, but assumed a fibrous appearance at the tensile fracture, due to the flow of metals.

4. Mr. Kreuzpointner not only gives his own opinions, but quotes eminent German authorities in support of the idea that changes in the component elements of iron are necessary for changes in its crystallization, and that these changes cannot occur at low temperatures.

5. The results of Dr. Wedding's researches are given to show, also, that repeated stresses cannot produce crystallization.

While, therefore, there is a strong weight of argument against the crystallization of iron in service, Wohler and Spangenberg agree that alternate and intermittent stresses tend to deteriorate and fatigue metals ; and Mr. Kreuzpointner says :—

" If we consider how, with insufficient dimensions and impaired cohesion, sudden shock will produce sudden fracture, then we have all the elements necessary to produce the well-known crystalline appearance of the fractured surfaces.

"The fractures will thus appear crystalline, even if the iron were ever so fibrous, because of the suddenness of rupture which did not allow the metal time enough to flow, giving, consequently, a clear transverse break of the fibers, which, as already explained, are nothing but elongated crystals, the transverse sections of which are the measure of their sizes."

Wohler declares, as the result of his experiments, that "the members of structures which are subject to alternating strains, pulling and pushing, or bending and twisting, ought to be made larger in the proportion of 9 to 5."

Pieces of iron, planed, polished, and etched, are said to give "undoubted evidence of the crystalline conditions existing before the iron was ever subjected to any strain."

The foregoing seems to establish that, though there may be the weakening of stamp stems by repeated shocks, which finally may cause them to break suddenly, thereby showing the crystalline faces of the iron to great advantage, there has been no enlargement in service of such crystalline faces in the iron.

H. M. HOWE, Boston, Mass., (communication to the Secretary)—Will Dr. Raymond let me modify the statement, which he gives, *Trans.*, xxiii, 560, of my position in regard to the crystallization theory of rupture under repeated stress and vibration ? My argument on page 196, *et seq.*, of my Metallurgy of Steel, was that, though it was quite conceivable on *a priori* grounds that vibration might make iron crystallize, yet there was no evidence that it ever does. My summing up was that we have "every reason to believe that the granulation and crystallization of iron under vibration and shock is a myth."

We seem to be at cross-purposes with Mr. Argall. He seems to think that people have denied that iron under certain sets of conditions, some of which include shock and vibration, breaks with a crystalline fracture : whereas, so far as I know, nobody has ever denied this. It is not the occurrence or a crystalline fracture but its explanation that is in dispute. I suppose that he must have fallen in to this confusion ; for I see no other way of accounting for his setting forth the undisputed crystalline fracture of stamp-stems in such a way as to imply that it answers the question at issue.

Let me try to sum up briefly the condition of our knowledge. Repetitions of stress, wholly unaccompanied by vibration and shock, are well known to induce some kind of deterioration which eventually breaks iron. Vibration and shock, unaccompanied by great stress, or at least by prolonged repetition of considerable stress, have never, so far as I know, been known to break it. This points to repetition of stress, and not to the vibration and shock which only in certain cases accompany or cause it, as the real cause of such breakage.

Examination of the fragments of pieces thus broken by repeated stress, even when accompanied by vibration and shock, has indicated that the injury was local ;* and careful microscopic examination of the fragments close to the fracture has detected no crystalline change, but at most a shattering and incipient separation of the pre-existing particles, grains or crystals whichever you call them.† All the evidence has been thus against the theory that vibration caused even a local crystallization.

The crystallization-theory thus was a discredited one. Fresh evidence might indeed rehabilitate it. But I fail to see that Mr. Argall has given us the faintest ray of evdidence or of reasoning in favor of that theory.

We know that iron, if nicked on one side and bent backwards, yields a fibrous fracture, but that the same bar, if nicked all around and broken with a sharp blow, yields a crystalline one. The two different modes of causing rupture induce it to follow different paths, and yield different fractures ; for the fracture is nothing more than the path of rupture. In this case nobody supposed that nicking all around and breaking with a single sharp blow has crystallised the iron ; it has simply developed a new path for rupture. Thus a crystalline fracture is shown to be no proof, but at most only a suggestion, of crystallization. The planes along which the rupture of the nicked bar travelled existed before rupture followed them, just as the cleavages in a feldspar crystal exist before I cleave the crystal with my knife, and as the image exists in the exposed but undeveloped photographic plate.

Mr. Argall vainly attempts to escape from the fact that "iron when fractured suddenly presents invariably a crystalline appearance : when fractured slowly its appearance is invariably fibrous," by his unqualified assertion that "In the first case the fibers are not given time to stretch, but are broken off at right angles to their longer axis, whence the apparant fine crystallization ; while, in the latter case, actual crystals are developed in the iron, some reaching as muce as 0.25 inches in diameter."

Let us see how trne this theory is. First so far as our present evidence goes, there probably are no fibers in iron such as Mr. Argall supposes, prior to rupture. Its particles apparently are nearly equiaxed.

Next, when a crystalline fracture forms in suddenly breaking iron, its faces are not as Mr. Argall asserts, at right angles to the imaginary fibers, or to the axis of the fibers which would actually have formed during fiber-favoring rupture. They are in general approximalely at an angle of 45° with those axes.

Finally, it is not the suddenness of breaking, as such, that gives us a crystalline instead of a fiberous fracture ; for in certain extremely rapid breakages, as for instance when a bar is torn apart longitudinally hy an explosion of gun-cotton, we get invariably a silky fibrous fracture.*

The simple truth is that each new mode of causing rupture seems to direct it along a special peculiar path, and causes a special fracture. The fracture thus depends jointly on the properties of the material broken, and the conditions under which breakage occurs. Why rupture follows this or that special path under special conditions, is for the elastician and mathematician to determine with great care.

Even for them the question is no easy one ; and it certainly cannot be brushed aside oft-hand or answered at random by those who run.

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* Baker, Trans. Am. Soc. Mech. Eng., viii., p. 163, 1887. Howe, The Metallurgy of Steel, p. 199, Column 1. Sorby, Journ. Iron and Steel Inst., 1887, i., p. 265.

† Martens, Stahl und Eisen, vii., p. 238, 1887. Sorby, Journ. Iron and Steel Inst.. 1887, i., p 265.

* Maitland, "The Treatment of Gun-Steel," Proc. Inst. Civ. Eng., lxxxix., pp. 120, 121, 1887.

With these facts before us, shall we wonder if the special set of conditions under which breakage occurs in stamp-stems directs rupture along still a new special path, and thus yields a special kind of fracture ? Is this special kind of fracture really any stronger evidence of crystallization than the other kind of crystalline fracture which we had long known that we could cause by nicking all round ?

The defenders of any discarded theory, of this one as of the corpuscular theory of light, need not trouble themselves to show that their theory is conceivable ; that it does not violate "any law of modern physics or of the molecular theory of matter." What we need is evidence which this theory explains, and which other theories cannot explain. We have no room for theories which are simply conceivable or even possible. We want those which are probable through evidence. But evidence, like the fracture of stamp stems, which accords equally well with either theory, really helps the accredited theory but does not help the discredited one.

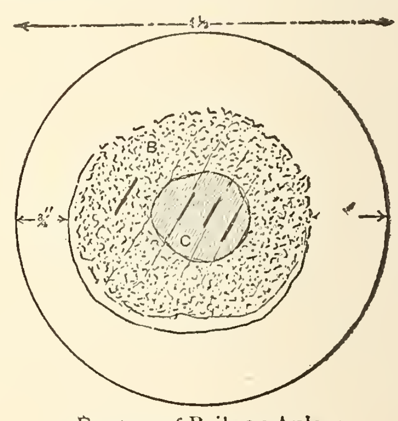
If Mr. Argall or Mr. Wilkes will send me a piece of broken stamp stem containing the fracture, I will gladly try to procure some evidence which will count, whether it be for or against the crystallization-theory.

It seems to me that the chief teaching of this discussion is care in the use of words. Had Mr. Argall contented himself with saying (*Trans.*, xxiii., p. 557), not "vibration under all conditions will crystallize iron," an assertion certainly wholly unjustified and probably very far from the truth, but "severe shock will eventually weaken or destroy iron," he would have asserted all that was necessary for his purpose. By going beyond this, and needlessly asserting that *all vibrations* injure iron, and by specifying that the particular way in which they injure it is by causing a crystalline change within it, he gave criticism a most pressing invitation.

His calling those whose opinions he attacks, "dogmatic theorists" seems unfortunate. If by theorists he means those who habitually study the causes of the phenomena, or "theories," he simply says that their habits should qualify them to form trustworthy opinions as to the cause of this pheaomenon. If he means that they are ignorant of the conditions under which metals fail in practice, he is simply mistaken. And as to dogmatism, those whom he attacks have not *denied*, but *questioned* and *doubted* crystallization by vibration; while he positively asserted at first that *vibration under all conditions* will crystallize iron; and his later modification merely limits the proposition to certain conditions, without changing its character as a positive assertion. It is bad enough for the sceptic to be excommunicated, but to be called *dogmatic* to boot, and by the Pope at that, would be rather bewildering.

DR. RAYMOND—Since the foregoing discussion took place, I have received from Mr. Argall, in a private letter, the following statement, which seems to me worthy of preservation in the record as a pertinent observation. He writes that on the 24th of July last, he was delayed for some time near Hill City, South Dakota, by reason of the fracture of an axle under the tender of Burlington engine No. 256 : "The axle broke off close to the wheel; an old and rusty crack, varying in depth from three-quarters to one inch, ran completely round the journal; next came coarsely crystalline iron, while in the centre the iron was beautifully fibrous, and showed the bars from which the axle had been forged. These, by the way, as indicated by heavy lines in the drawing, were not properly welded."

The accompanying figure made from a pencil sketch in Mr. Argall's letter, illustrated his statement. I will only observe as to the conclusions to be drawn from this case, that the facts seem to me consistent with the theory of progressive fracture, and with the well-known relation between the nature of the stress causing fracture and the appearance of the fracture-surface.



Fracture of Railway-Axle.

The indications of imperfect welding observed by Mr. Argall may fairly be taken as evidence of improper heat-treatment for the process of forging ; and this, as has been emphasized in the present discussion, is a source of crystalline structure (or, more precisely, of that condition which yields a crystalline or granular fracture under circumstances in which a fibrous fracture would otherwise be expected). The existence of the old crack round the outside seems to indicate that this part of the mass was in such a condition as to break without such elongation as might have held the whole axle together, until a fibrous fracture of the whole had been effected. In other words, improper heat-treatment may have over-heated the outside and under-heated the centre of the forging, so that the former became "crystalline," while the latter, not hot enough to weld perfectly, retained the capacity of elongation before fracture, which is called "fibrous structure."

On this hypothesis, the axle, if broken at any time after manufacture, would have shown on the surfaces of fracture a difference of quality between the outside and the inside. But it should not be forgotten that such a fracture would not fairly represent the process of repeated shock and stress undergone by the axle in practice. Even if the material were uniform throughout, the peculiar nature of the stresses to which it was subjected might well develop differences in the successive fractures of different concentric parts. Recent experiments have proved the somewhat surprising fact that locomotive wheels advance not in constant contact with the rails, but by a series of jumps. If I remember correctly, these experiments were confined to driving wheels ; but it seems to me that the same proposition must be true in some degree of all railway wheels, especially those which are nearest to the drivers, and thus receive most directly the effect of the successive jumps of the latter. We have to consider, in that case, the effect of trasverse blows, repeated at the rate of 1,000 to 2,000 times per minute. Considering this rate of rapidity, and the weight supported by a railway-wheel, I think I am justified in saying that the test is more severe than that to which stamp-mill practice subjects the stem of a stamp. But the effect of this series of blows is doubtless somewhat different. Each shock exerts a tensile strain upon the lower, and a corresponding strain of compression upon the upper half, of the axle. It is obvious that, by virtue of the revolution of the axle, every part of the circumference experiences these strains in rapid alternation, and that every part of the interior experiences them in degree dependent upon distance from the neutral axis. On the assumption of the complete homogeniety of the axle as to structure, condition and internal strains due to heat-treatment, it would still be natural to expect that the outer portions (under stresses not sufficient to rupture the whole mass practically at once) would break not only first, but with the smallest amount of elongation, and that the central portion, breaking last, would show the greatest elongation before fracture, because it would have been exposed to gradually increasing stresses, as the progressive fracture of the outer concentric portions increased the intensity of stress upon those remaining. Another point deserves consideration, namely, that up to a certain stage in such progressive fracture, both bending and elongation of the outer layer are resisted by the rest of the mass, a condition which diminishes with the decreasing diameter of the unbroken central portion.

If it be supposed that the axle, by reason of its heat-treatment in manufacture, or for any other reason (such as different quality of its original parts), was not homogeneous in the respects mentioned above, the differences in its fractured surfaces might be increased. The instance cited by Mr. Argall, therefore, while it may be consistent with the notion that the railway axle in question was once wholly fibrous, as at C, and had become, in use, crystalline at B, before its fracture, does not require or prove that theory.

R. A. HADFIELD, Sheffield, England (communication to the Secretary)—I have long entertained the idea that many of the so-called fractures by vibration were really due to previous, and often careless heat-treatment. I can say, after personally handling a very large number of specimens, that I have never yet found a case which could not be satisfactorily explained when the previous heat-treatment could be traced.

F. OSMOND, Paris, France (translation of a communication to the Secretary)—Having read the discussion of this subject as printed thus far,* I take occasion to say that I am fully in accord with Dr. Raymond's view. I know of no fact which demonstrates the crystallization of iron by vibration; and all that I do know is opposed to that opinion. The aspect of the fracture depends upon the original quality of the iron and the mode of rupture.

As to the formation of *beta*-iron by shocks and vibrations, that is another question. As Dr. Raymond has correctly pointed out, it is only in the case of permanent deformations that the production of *beta*-iron can be seriously argued. It appears to be, however, not impossible that the elastic limit may be exceeded *without apparent deformations* under the action of vibratory forces which operate at each point for an extremely short time only. But this is a mere hypothesis. If it is well-founded, it could be verified by determining the coercive forces of the iron before service and after rupture. The production of *beta*-iron would be indicated by an increase in permanent magnetism. The truth is, we know at present almost nothing as to the transmission of mechanical waves.

* Not including the present pamphlet.—R. W. R.

Mining Reports and Mine Salting.*

By Walter McDermott.

There is such a great variety of badness in mining reports that a little grouping of the cardinal sins will be useful. In speaking of mining reports generally, for the purpose of illustration, I intend to cover, not only those made by mining engineers, but all those used in business, and so fairly subject to criticism,—from that of the learned professor of other sciences who is dragged from ths seclusion of his study and put underground to be made miserable with candle grease, down to the practical miner, who, having beaten a drill for a certain number of years, is prepared to dogmatize also on facts, figures, theories and conclusions.

Amongst the old friends we meet in numberless reports, and which seem to need a little protection against excessive wear and tear, the following will be considered: (1) the true fissure vein; (2) increasing width in depth; (3) increasing richness as depth is attained; (4) junction of veins; (5) ore in sight; (6) proximity to a rich mine; (7) failure from mismanagement. Now, Heaven forbid that I should be held as speaking disrespectfully of any one of these things, each estimable in itself. My remarks are pointed only against their indiscriminate use, and particularly against their public use as catch-penny phrases in a way to imply more than they actually mean.

There has been more joy over the term "true fissure vein" than over anything else in the history of mining. The investing public has become intoxicated with the exuberance of its descriptiveness. The practical miner has grasped its effectiveness, and the first ring of his pick on an outcrop satisfies him that he has got the the genuine article with tap roots in the antipodes. What is a true fissure vein? It is supposed to be a fissure in the country rock filled with veinstone, which may be expected to go down to a considerable depth. The veinstone itself sometimes carries pay ore. This does not seem much to base any elaborate calculations on; and not only is it insufficient, but experience all over the world has shown that some of the most valuable ore deposits are not found in fissure veins at all. Even as far as mere depth is concerned, it is by no means yet established that true fissure veins go any deeper into the earth's crust than bedded deposits, contact, or pipe veins; and it would be of no consequence if they did go deeper, since they cannot be followed. Properly used, the term "true fissure" is usually descriptive, but where used as an incantation to call up visions of wealth to unlimited depth, it needs suppressing.

It is naturally gratifying to the owner of a mine to see his vein increasing in width as he goes down. It also looks well as described in a report, and must naturally be mentioned when it occurs; but in some reports the implication arises that it is a vital point and to be calculated on as continuing. If a vein went on increasing in width, it would very soon attain enormous dimensions; and, if it outcropped in a country blessed with the law of the apex, its lucky owner would have a good claim to a very large proportion of the earth when he got down a few miles. It may pretty safely be assumed that the increase in width will not continue, and, when it stops, it is very likely to be succeeded by a corresponding decrease, so as to keep upt he usual average of things. When, say, a 50 ft. shaft sunk on a vein shows an increase in thickness from 1 ft. at surface to 6 ft. at the bottom, there is nothing to show that, in continuing to sink, the vein may not gradually or rapidly pinch again to its size at surface, or even much less. If any calculations were justifiable at all in such a case, general experience would certainly lead one to expect such decrease. The only positive conclusion would be that the vein is irregular in width. It looks nicer and more definite to say simply, "the vein is steadily increasing in width as sunk on," than to state that "the width of vein is variable, running from 1 ft. to 6 ft., and therefore, until further opened in length and depth, its average cannot be safely calculated on." The one statement is as true as the other, but the effect of the two in reading is not the same.

*Abstract of a paper read before the British Institute of Mining Engineers.

There is a touching confidence in the belief of many practical miners that veins get richer as they go down. Experience and disappointment often fail to shake this comfortable belief. Most practical men are able to cite a great many more examples of rich mines becoming poorer with depth than the reverse. I remember being struck with the inconsistency and persistency of the belief in depth in various camps of the Rocky Mountains. Up in the highest ranges, say 12,000 ft. above sea level, there are mines which need sinking on to prove their real value; and 7,000 ft. below them in the foot hills are mines equally needing depth. Probably the thought at the bottom of this belief rests, like some of the attractiveness of the true fissure veins, in the old idea of a central seething mass of precious metals, and in the forcing up of a molten vein-filling. This faith in the saving grace of depth and of true fissure veins in the face of facts can be explained only by the definition of faith as given by the little girl—"believing what you know is not true." The hankering for depth has its justification of course, in the necessity for sinking usually to get any developments, but, where access is obtainable to the foot of a mountain through which a vein runs, the same men who claim a special efficacy for depth in other cases will point to the vast advantages of having the ground above one to be opened by adits. The facts of experience show that, when a vein is rich at the surface, a hope that it may continue is a more proper attitutde than a belief that it will get richer in depth; and, when it is poor on surface, any change in sinking would be for the better.

Striking cases of enrichment of veins at their junctions occur; but, as many examples of junctions without richness also exist, it does not do to attach too much importance to the results to be expected. In some reports the future junction of two veins is often itself assumed on insufficient data, and the consequences are calculated on with a certainty which is still less to be justified.

Under the head of "ore in sight" is included matter which is of the very greatest importance, and which requires the very best work of an engineer. The estimation of ore in sight in an opened mine often involves the consideration of so many points, and is so largely a matter of good judgment, that one may expect some discrepancy in the reports of different engineers. There is nothing in which such vast discrepancies do exist, in fact, as in regard to this. Two good engineers will vary in their estimate; and, when it comes to inexperienced men, or to so-called practical men who have no reverence for the written word, the term "ore in sight" becomes a theme for the exercise of the highest flights of the imagination and the airing of a little rudimentary mathematics.

In the common mining report we are all acquainted with, it is not unusual to see the length of the chain multiplied by a cheerfully assumed average width of vein, then by 500 or 1,000 ft. for depth, and a tonnage deduced which reminds one of the figures used for astronomical purposes. Sometimes, to inspire extra confidence, the expert generously knocks off 25 or 50 per cent., and feels he has then done his duty, whatever happens. The character and ability of a man can sometimes be closely estimated from the way he figures up ore in sight after giving the dimensions bearing on it; and it often suffices to look at this calculation in order to determine a report to be, not only quite unreliable as to conclusions, but equally irresponsible as to data.

In connection with estimation of ore in sight, the system of sampling employed is worth mentioning here. In some reports the expert writes of taking samples "at random.' When a man says he has picked some samples from a dump "at random," and they assay well, he implies that such ore is plentiful on the dump, and that he did not purposely select it from its appearance. What his statement actually means is that on an important matter he was willing to trust to luck as to whether he hit poor or rich ore, or whether he was getting just what had been previously placed for him to get. Luck is a very necessary thing in mining, but it should not enter into sampling. If the sample is a random one, its value proves nothing. Some people seem to think this method of sampling is important evidence of an impartial mind, and that shutting the eyes is the best security against the frailty of human nature, which would otherwise lead a poor creature to pick out the richest looking ore he can find.

Another little weakness to be remarked in some reports is the willingness to make a liberal discount off the expert's own figures. The writer concludes, for instance, from his samples—perhaps taken at random—that a gold vein will average 2 ounces of gold to the ton, but, to be on the safe side, generously offers to take it at 1 ounce, and then with a light heart goes into calculations of profits by day, and month, and year. If a man knocks off 50 per cent. from his supposed reliable figures to be safe, it always occurs to me that the one who reads his report may feel tempted to lop off another equal percentage to be still safer.

There have been plenty of illustrations lately published in prospectuses of the great value the public places on a property which is near a well-known mine; yet everyone who knows anything of mining must be aware that mere proximity to a paying mine gives no assurance of similar success. Some of these reports are absolutely nothing but a statement that the claim examined is on the same reef as, or near to, another property which is popularly supposed to be exceedingly valuable, and that rich ore has been found on the claim.

In quartz mining it sometimes happens that a series of paying mines are found at intervals along a single vein. Occasionally the intervals between pay shoots are long, so that a good mine may be immediately surrounded by poor ores. In other districts one single good mine on a vein is all that is ever developed. The only actual advantage of the proximity of a good mine is the evidence it affords of there being payable ore in the district, or on a certain reef. Like other indications, it is of service only when used with discretion, but as an unqualified argument of the value of a neighboring claim it is most dangerous.

That bad management may spoil a good mine is so self-evident a proposition that no one will misunderstand a few remarks against the improper or thoughtless use of this excuse in a report as an explanation of previous failure in a poor mine. A well-known Californian mining man, when asked to take charge of a mine which had failed to pay—as it was explained—from mismanagement, answered that he did not want anything to do with a mine which would not stand bad management. This is a remark which contains much matter for reflection, and embodies the opinion of most practical men. In reports the statement is sometimes loosely made that milling results in the past cannot be relied on, owing to primitive machinery or processes hitherto employed. This argument has often been advanced on Mexican mines by experts who have not had time to find out that native methods of working often give better results than the rapid working by the most modern machinery.

After all these remarks as to what mining reports ought not to be, it is perhaps permissible to say a few words on what they ought to be. A report need not be long-winded to justify the fee paid for it, but should be so full in actual description as to enable a reader experienced in mining to draw his own conclusion from the facts given, without having to trust entirely to the deductions of the writer. Where a fee is paid for a simple expression of opinion or specific advise, there is no need of a report, in the sense of the word as we are now considering it. The important details to be set forth clearly are those relating to position, and facility of access to the property; local conditions as to fuel, water, and timber supply; extent and form of openings; variations in thickness of deposit; character and value, and form of occurrence, of ore. It is important in giving a clear idea of the property that the distribution of the payable ore in the deposit should be described. It makes a great difference sometimes in the conclusions to be drawn whether the value consists in rich ore occurring in a barren vein mass, or in high-grade ore scattered through a low-grade deposit, or in a uniform value throughout the rock. On account of the necessity for this description it is not always sufficient to state that an average width of vein contains an average of so much value per ton, as this may be in the nature of a conclusion, not of a fact, and so may need to be justified by detailed facts of the report. The extent and character of dump piles at a worked mine often afford valuable confirmatory evidence as to the character and value of the property.

Geology and mineralogy should naturally be used with discretion, but only for purposes actually bearing on the description and conclusions to be drawn,—not for mere padding nor for the airing of theories better treated in a purely scientific paper. I have seen a report which started with the nebular hypothesis and traced the progress of the earth from its pulpy state right down through its various stages to oxidation of the outcrop of a particular vein in the year of grace in which the report was written. These details were so full that there was no room left for anything but a very brief treatment of the merely commercial question of the value of the mine.

Examinations naturally differ greatly in the nature of the calls they make on the expert. In a district with which he is well acquainted there are often certain simple facts which enable him rapidly and safely to arrive at his own conclusions ; in other cases it is often a matter of hard and concientious work, however clever or experienced the engineer may be, and any scamping of this work will imply unreliableness. An experienced man in making a report will have an open mind for possible new forms of ore occurrence, while refraining from prophecy about things not in sight. Events may work against the most careful and experienced man by unforeseen increases or decreases in value on opening new groand ; but as mine examination is an art and not an exact science, it is by average results that an engtneer must be judged.

There are all degrees of "fixing a mine" ; from the legitimate showing of its best features by not taking out all the rich ore before offering for sale, or by various degrees of skulduggery, up to palpable salting of mines, dumps, and expert's samples. In the less illegitimate stages much can be done, and very frequently is done, in the way of a judicious stoping of faces in good ore, and by the observing of a discreet silence as to past weaknesses and irregularities of the ore deposits. In such cases it is simply the ordinary commercial position of "let the buyer beware," and the expert has to show by his report if he has experience, observation, and sense enough to form a sound judgment as to value.

In a mine which is thus carefully prepared for selling, it is not at all uncommon for the owner to go beyond the legitimate limit already indicated, and to misrepresent facts by filling up or concealing old workings which would, if examined, produce an unfavorable impression. The next step in the downward path which leads to a hotter place (but in the meantime also sometimes to affluence) is the scooping-out of the inside of apparently solid blocks of good ground by openings afterwards filled up or timbered over. Some of the most experienced mining men and engineers have fallen victims to this and the previously described course of conduct ; while some have just escaped being caught by a mere accidental indication of the fraud, or by "peaching" of some miner who helped in the work and had not been squared. Naturally the danger from the sources mentioned is much less in new mines of limited extent than in old mines extensively developed. In a mine which has been worked for some time the visiting engineer is at a great disadvantage as compared with the men who have worked in it for years, and perhaps devoted their greatest skill to making, not only a good record, but to concealing the exhaustion which is approaching. It happens occasionally also that the owners complete their work by "picking the eyes out of the mime" in the interval between the expert's report and the turning over of the property to the purchasers. The richer the nature of the pay ore in the mine, the greater the danger from this rascality, which needs specially providing against in the terms of purchase, and by other precautions.

The above-mentioned very real and not uncommon dangers, against which the engineer has to guard, are not, however, "salting" in its proper and technical sense, which is generally understood as covering any interference with the expert's chance of arriving at a true estimate of the value of ore. The salting may be done on the ore before the expert's arrival, or during his sampling, or on his samples when taken, or while panning or assaying.

Although cases are well known of faces in a mine being salted with such success as to catch the unwary, this form of salting is usually too difficult to carry out, and too superficial in character to offer much chance of catching an old bird. With ore dumps and alluvial deposits it can be done with better chances of success, but is naturally of an expensive nature if carried out on a really systematic plan. Cases are on record of successful salting of alluvial ground with precious stones as well as with gold, and the expert must clearly be on the watch against this, when circumstances allow of the possibility of its occurrence. With ore dumps it is often very easy to arrange a veneering of good ore over a very large pile of poor or barren rock, and then, when the ingenious gentleman who takes samples "at random" comes along, he will be sure to obtain a gratifying result.

The salting of samples is, however, much more common than any other form of getting ahead of the expert. It is less expensive than salting in advance, more deadly, and can be nicely adjusted to circumstances and to the individual weakness of the victim. When the owner of the mine, or anyone connected with him, is allowed to assist in the sampling itself, there is no lack of opportunity with some ores for the artistic salting while in the mine ; but, as a rule, engineers do not have the requisite faith in human nature to accept such assistance, unless the character of the ore and kind of samples required make salting impossible at the time. In a strange district, where assistance of some sort has to be obtained in breaking and transporting large samples, and the character of such assistance is not absolutely certain, the engineer must guard himself by duplicating entirely alone certain test samples. Assuming that samples have been secured without any chance of outside interference, the business is by no means ended, for the enterprising salter will follow those samples until actually panned or assayed, or taken out of his reach.

To the successful cultivation of the art of salting no great knowledge or experience of mining is necessary, any more than a study of architecture is essential to the practice of burglary. True ability will assert itself in this as in other employments by the invention of new means to meet special cases, and by a proper discretion in regulating the dose of salt administered to the temperament of the patient. Sometimes the honest miner will freely relate stories of methods by which experts had been salted, implying delicately that no such scheme would be successful with his hearer, but reserving one, undescribed, for purposes of personal illustration later.

The microscope or a very strong glass is often of very great service. In silver ores the silver-bearing minerals can often be washed out and identified ; and with gold ores the color and form of the metallic particles are sometimes suggestive. Once, in Dakota, I was taken to see a vein said to be rich in silver, but the appearance of the vein-matter raised an immediate doubt as to what form the silver could be concealed in. By panning I obtained some native silver ; but when examined under a glass some of the pieces showed traces of native copper attached. The only place I know where native silver and copper occur actually welded together is the copper region of Lake Superior ; and, on questioning a little the honest miner who was my guide,—and who had kindly assisted in crushing some samples,—I found he had formerly worked on Lake Superior. No great intellectual effort was then necessary to account for the occurrence of the silver in the very unpromising looking vein-matter.

In the case of panning tests on gold ore, or gravel, or for precious stones, it is of course comparatively easy for anyone who is allowed to be within a short distance of the expert to get in his salting work, and solitude is the only protection. The salter may use a quill tooth-pick as a weapon for long-range shooting, or have gold dust in his nails for short range ; or charge his pipe or cigar, and not watch where his ashes fall. Cases have been known of gold pans prepared in advance by a valuable varnish which gradually rubbed off in use. Although it is not possible to mention all the devices, there may be some utility in putting on record for others the better-known ones ; for it is certain that many young engineers start out with confidence of much learning, ready to undertake responsible examinations, and without any clear idea of the dangers they are courting. A man may acquire a fair amount of practical experience, and confidence begotten of the same, without happening to get into surroundings of any real danger, and so, when least expecting it, may yet be nipped. All men of experience agree that the only absolute protection is solitude ; and that trusting to knowledge of the old tricks or to personal watchfulness is quite insufficient if any person is immediately around.

General Mining Association, Ltd.

A Dividend of 12¾ Per Cent.

The Ordinary Half-yearly General Meeting of the shareholders of this Company was held at the offices, London, England, on 19th ulto., when the report and accounts for the year ended 31st December, 1894, were submitted as follows :

"The sales of coal were as follows :—

	1894. Tons.	1893. Tons.	Increase. Tons.
Sydney Mines	236,125	209,185	26,940

The profit on the year's trading, as set forth in the accounts, amounts to	£19,002 12 11
Brought forward from 1893	684 14 1
	£19,687 7 0
Out of which the Directors propose a dividend of 14s. per share, free of income tax, viz	19,228 6 0
Leaving balance to carry forward	£459 1 0

From the commencement of the shipping season there was a good demand for coal, and the total shipments exceeded those of any previous year.

The financial crisis in Newfoundland, with which colony our transactions have always been important, will, it is feared, eventually result in a loss to the Association.

It is as yet difficult to form a reliable estimate of this ; the Board have, however, provided for what it is believed should fully cover it, and, after so doing, are able to recommend the dividend above referred to, which they believe will be considered very satisfactory, especially when it is remembered that a return of £2 10s. per share on capital account was made on 24th September last.

The Board are continuing to sanction such improvements as will tend to facilitate the shipping and delivery of the coal."

Report of the Mine Manager.

I beg to submit the following annual report on this colliery for the year 1894 : We employed an average number of 288 colliers during the season ; the pit worked 272½ days drawing coal; and the total quantity of 256,812 tons of coal was raised. But little shipping was done early in the year ; only 11 cargoes were shipped in January, 1 in March, and 6 small cargoes in April. From the 1st of May, however, until the close of the year, the demand for coal was steady and continuous. The total shipments for the year were 218,028 tons, and the local sales 18,096½ tons of large, run of mine and slack coal. Early in the season our western shipping pier at North Sydney was repaired, about 50 feet were added to its length; the trestle work or superstructure which carries the roadway, was entirely renewed, and the roadway raised to a height of 6 feet above its previous level. The bridge, whereby the roadway to this pier crosses the public road, was also renewed and raised in height. A new and powerful locomotive, built to specification, by the Baldwin Locomotive Works at Philadnlphia, has been purchased ; and 21 coal cars, to carry 6 tons of coal each. have been provided.

A Fairbank's truck weighing scale, to a capacity of 20 tons, was imported and set upon our railway. A new ventilating fan of 10 feet diameter was purchased and set up, to be used when necessary to assist or replace the old Guibal fan. Hadfield Cast Steel Wheels were, during the season, supplied and fitted to 210 of our pit coal tubs or boxes, to replace the cast iron wheels hitherto in use. A boiler feed heater was purchased, and set up in connection with the exhaust steam from our large winding engine, to warm the feed water for the use of our boilers. 1,251 yards of the 4in. iron pipes, which conduct the boiler feed water from the main reservoir to the pits, have, during the season, been replaced by pipes of 5 inches diameter; and a bore hole 283 feet 4 inches deep by 5 inches diameter, has been bored to a small feeder of pure water in the vicinity of the reservoir. This feeder is available during dry weather, either to supplement the supply from the reservoir, or to provide some of our workmen's houses with good water. A pair of new cylinders have been imported for the locomotive 'Stephenson,' and will be put in this winter, as soon as the locomotive 'John Bridge,' which is having a new fire box fitted at New Glasgow, shall be completed. Repairs, as usual, have been made on a number of our stationary boilers, on our coal tubs, waggons, railroad and plant generally, and everything is in good working order. Progress has been made with the erection at bank of the 'Lingan' engine, to be applied to work the north side underground haulage ; and some new slidings, spears, or guides, of pitch pine, have been placed in the winding shaft. One breakage only occurred during the year to our main pumps. In June the clack door piece in the Staple set, which had been cracked for some time, gave out and had to be withdrawn and replaced by a new one.

(Signed) R. H. BROWN.

Accounts for the Year Ended 31st December, 1894.

BALANCE SHEET.

Liabilities.

	£ s. d.	£ s. d.
To Share Capital, viz., 27,469 shares of £8 each	219,752 0 0	
Less £2 10s. per share repaid to shareholders	68,672 10 0	
		151,079 10 0

To Sundry Creditors—			
At the Mines		3,078 12 3	
At Halifax		2,248 16 11	
In England		1,149 6 8	
Unclaimed Dividends		312 11 0	
do Return of Capital		1,256 10 0	
			8,045 16 10
" Reserve—			
Per last account		29,850 0 0	
Maintenance and Renewal Account—			
From 1893	£38,750 0 0		
Sydney Mines, for current year	1,500 0 0		
		40,250 0 0	
			70,100 0 0
Low Point, Barrasois and Lingan Mining Company, balance subject to collection of book debts			4,047 4 8
" Profit and Loss—			
Balance from 1893		684 14 1	
Profit this year, per Account "B"		19,002 12 11	
			19,687 7 0
			£252,959 18 6

Assets.

By Property of the Association, viz.—		
Pits, Railways, Engines, Wharves, Buildings, Machinery, &c.	123,201 9 8	
Other property, including real estate, stores, mining implements, &c., valued per inventory	41,031 17 6	
		164,233 7 2
" Sundry Debtors—		
At Halifax	21,953 18 4	
At the Mines	2,870 1 4	
		24,823 19 8
" Bills Receivable—		
In England	4,033 15 4	
In Halifax	6,398 5 9	
		10,432 1 1
" Government and Indian Securities	38,478 19 3	
Accrued interest thereon	407 8 9	
		38,886 8 0
" Cash—		
At Halifax	1,720 5 6	
do on deposit	9,246 11 6	
At the Mines	1,204 10 4	
At London bankers and office	2,412 15 3	
		14,584 2 7
		£252,959 18 6

B PROFIT AND LOSS ACCOUNT.

Dr.

To Coal stock on hand 1st January, 1894		648 18 11
" Sydney Colliery general working expenses, railroad expenses, shipping charges, royalty, &c.		61,994 15 11
" Maintenance and renewal of plant, railroad, wharves, &c.		1,500 0 0
" Management expenses at Sydney Mines		1,739 16 6
" Income tax (average of three years)		472 6 0
" Expenses of management in London—		
Directors' salaries	£900 0 0	
Secretary, clerks, and auditors' salaries	720 0 0	
Office rent, printing, advertising, stationery, telegrams, postages, travelling and petty expenses	630 10 3	
		2,250 10 3
" Legal expenses		286 1 5
" Bad or doubtful debts in Newfoundland		5,000 0 0
" Balance—Profit carried to Account "A"		19,002 12 11
		£92,895 1 11

Cr.

By Proceeds of sale of 236,125 tons of coal and miscellaneous receipts at Sydney Colliery		88,938 18 4
" Rents of cottages and lands		1,211 11 8
" Interest and exchange	2,218 19 4	
Less interest, etc., paid	119 16 4	
		2,099 3 0
" Transfer and other fees		2 5 0
" Profit on real estate sales		220 1 1
" Received on bad debts account		155 6 7
" Stock of coal 31st December, 1894		267 16 3
		£92,895 1 11

The Sinking of the Ladd Shafts.*

BY GEORGE S. RICE, E.M.

At Ladd, which is in Bureau County, Illinois, the coal measures are overlaid by a drift deposit, 160 to 200 feet thick, of clay, sand, and gravel, interspersed with boulders, sometimes of large size. It seems to have been the accumulation at the bottom of an ancient lake, as the material is in more or less regular layers containing shells and pieces of float wood which were found all the way down to the solid rock. The surface of the latter was evidently scoured by the great glacier and is level, if not slightly basin-like in form, as indicated by the prospect drill holes. The surface drains slowly till it reaches the bluffs of the Illinois river, which is distant, as the water flows, about eight miles from the shafts.

The result of this slow drainage above open sandy strata, and a slightly basin-like rock bottom, is to make the drift water-soaked and full of pockets of quicksand.

The coal seam worked at present is the third from the top, geologically, No. 2, and in the Ladd shafts is 460 feet from the surface, but after the 160 feet of drift is pierced, sinking presents no especial difficulties.

The officials of the Whitebreast Fuel Co. were made aware by their prospect holes that water was to be encountered, but did not expect the enormous quantity nor the treacherous ground, consequently, the beginning of the work was marked by several unsuccessful attempts. The ordinary methods of cribbing and spiling were first tried, and then an ordinary timber drop shaft. But, in addition to large quantities of water, much difficulty was experienced on account of the variable nature of the ground, alternating hard and soft strata, the presence of boulders, etc. This made a drop shaft impracticable, since it would settle unevenly and could not be controlled.

Success was finally attained by introducing a heavy steel shoe, which was forced ahead of the lining by jackscrews, additions being made in sections to the lower edge of the lining. In principle this is similar to the method of tunneling in soft ground with the use of an advance shield, and is almost identical with the old Guibal system, first employed for shaft sinking about 1856, with this difference: that in the Ladd shafts, the shoe was rectangular instead of round.

Four shafts were begun, one after another, the fourth having actually reached solid rock, and lacking but little of completion, when the curbing near the bottom gave way, and a strong inrush of sand and water destroyed six months' work.

The first shaft was started June 1, 1888, by experienced sinkers. The customary method of sinking through drift was employed, that is, excavation was followed closely by timbering with 2 in. by 12 inch planks laid flat. The water was handled first with barrels. At a depth of 50 feet water and sand burst up from the bottom, and the cribbing became so swung and twisted that the shaft had to be abandoned.

The second shaft was started in the latter part of June, 10 feet west from the first, which was to be used as a sort of sump until the second shaft had gone below it. When the second shaft did get below the first, great trouble was again experienced from water and sand. Spiling was tried, driven in advance of the timbering around the edges, but the rushes of sand and water threw them out. Meantime a pump was put in; but at a depth of about 70 feet the rushes were so strong it was found that ordinary methods would not do. A heavy wooden shoe was proposed, to be sunk from this point, building the curbing on top of it, in other words, making a drop-shaft through the very soft ground from the point where the ordinary method had stopped. The ground back of the gap where the successive rounds of timbers were added on, as the drop-shaft sank, was to be kept back by a stationary shield of plank outside the curbing. The shoe was made and started; it could not be made to sink evenly, and almost at once became distorted and stuck, and the rushes became so bad that the stationary curbing above was pulled apart and the shaft was so racked that it was abandoned.

Mr. Phillips now designed the steel plate sinking shoe and the plan of suspending the curbing on which he received Patents No. 424,819 and No. 424,820. The first experimental shoe may be briefly described as a steel plate box, open top and bottom, the upper part inclosing the bottom of the curbing, the lower part divided by plate braces into six compartments. The shoe to be hung when it was so needed, by chains to lines of iron rods running from trusses across the shaft at the surface. These rods were in the corners of the shaft and also helped support the curbing by means of cross timbers every 10 feet, through which they ran. The timbers were set into the curbing, and later when the curbing rested on the solid rock were to be cut out. While the shoe was building, the shaft in which it was to be placed, No. 3, was started about August 1, 1888. The cribbing was again of 2 inch by 12 inch planks laid flat, with two temporary lines of buntons of 6 inch by 8 inch timbers with 10 inch intervals. The outside dimensions of the shaft were 12 by 16 feet. It was planned when the shaft reached the solid rock to timber up with an inner cribbing 8 inches thick, puddling between the two cribs, leaving a shaft way 6 feet 3 inches by 10 feet 6 inches, divided by a partition 6 inches thick. The shaft was carried down 50 feet by ordinary methods before the shoe was ready.

The latter was taken down piece by piece, put in place and bolted together, which proved a hard job in the mud and water, but which was successfully accomplished. The shoe and the method of hanging the curbing proved a decided success, and sinking steadily proceeded to a depth of 125 feet. At this point, however, such a burst of sand and water came up from the bottom that it drove the men from their work. While the shoe had worked well, it had proved to be too light for the conditions and the compartments too large; so it was decided to let the shaft stand for the time being and put down another shaft, which might lessen the water and thus permit the work on this to be resumed.

Accordingly an improved and heavier shoe, with 15 compartments, instead of 6, was built, and on January 8, 1889, the fourth shaft was started, located about 50 feet east of the first. This shaft made good progress considering the severe winter weather, till a depth of 138 feet was reached, which was on March 8th, just two months from the start. But here there was a tremendous burst of water and sand, the water amounting to over 640 gallons per minute, which soon drowned out a large Deane pump with a 6 inch discharge, and a Blake with a 4 inch discharge. Before another pump could be brought into action, the water was 80 feet up the shaft.

Then followed long delays, while certain pistonless pumps were tried and found wanting. Very little sinking was done till May 9th, when it progressed slowly, meeting great difficulties. Boulders were encountered, which got under the edge of the shoe and had to be blasted, and bad rushes of sand and water. The sand added immensely to the difficulties of pumping. At times a man had to be kept constantly at work cleaning the suction strainers so they would draw. It also cut the valves and linings of the pumps, so that the pumps had to be changed and completely repaired at least once a week. The removal of the enormous bodies of sand and water from around the shaft was felt clear to the surface, which sank a foot or more in places over a large area, sometimes on one side, sometimes on another. This caused the shaft to swing and threw great strains on the supporting trusses and on the curbing. This was further aggravated by the uneven pulls of the shoe, due to its being hard perhaps only under one corner or side. These strains sometimes forced the cribbing planks from the level, and it would be necessary to level up again so that the shoe might descend vertically and the next courses would be tapered, that is, the planks would be adzed so as to be thinner at one end than at the other. This necessarily weakened the plank, and together with the strains from the general distortion of the curbing, was undoubtedly the cause of its giving away later. However, the shaft progressed to a depth of 158 feet, which was reached May 20th, and brought the crib within 4 feet of the rock. At this juncture the pumps on hand completely played out, and another delay ensued till June 26th, four days after which the rock was reached.

The shoe was then secured, the compartments were cut out, and the timbering carried down to the rock. The rock at this point proved to be 3 feet thick, and this

* School of Mines Quarterly.

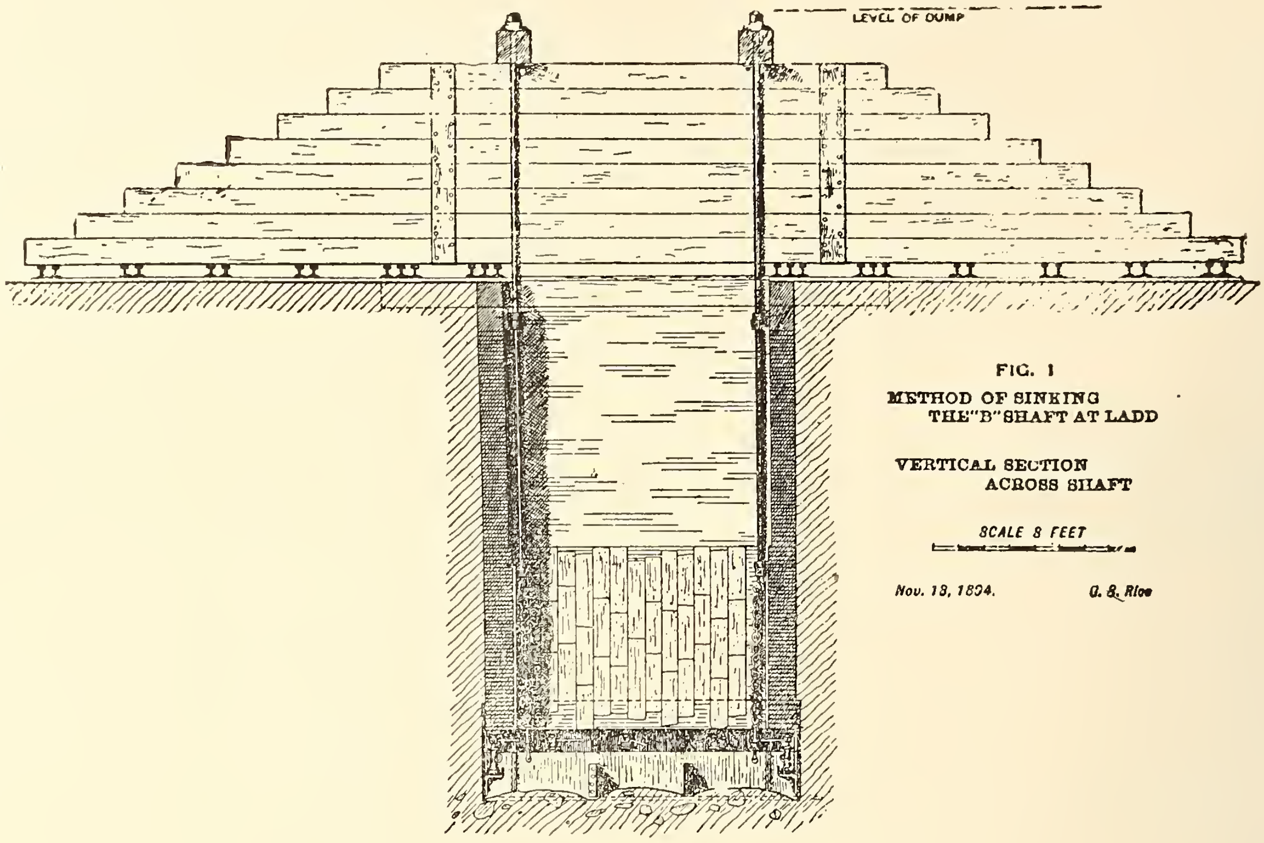


FIG. 1
METHOD OF SINKING THE "B" SHAFT AT LADD

VERTICAL SECTION ACROSS SHAFT

SCALE 8 FEET

Nov. 13, 1894. G. S. Rice

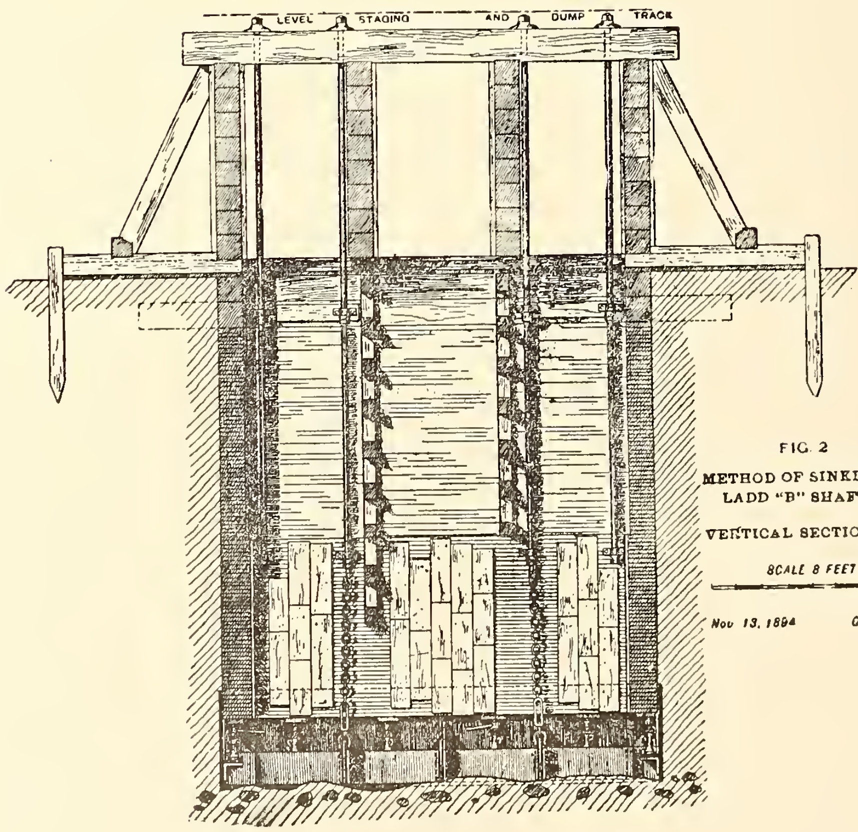


FIG. 2
METHOD OF SINKING LADD "B" SHAFT

VERTICAL SECTION

SCALE 8 FEET

Nov 13, 1894 G S Rice

was also penetrated to the shale immediately below. From this point the inside lining and puddling and permanent partition was begun, working upward from the bottom and removing the temporary buntons and cross-timbers as the work advanced. The inner linings had been built up about 8 feet, when suddenly the curbing gave way just above it, at the east end, flooding the shaft with sand and water. Fortunately this happened at lunch time, when all were on top but two men who were looking after the pumps; these barely got out, for in a few minutes the shaft had filled half way up.

This happened July 14, 1889. Not discouraged, the company soon arranged for another attempt. The shoe having proved successful, a duplicate one was ordered, but thicker cribbing was used for the lower part, namely, 2-inch by 14-inch planks flat. At one time the experiment was tried of alternating 2-inch by 12-inch and 2-inch by 14-inch plank, made flush inside, but presenting a rough exterior; the idea being to give the shaft a better hold on the ground, also to make it less easy for the sand and water to wash down outside the cribbing. However, in practice it did not prove of any particular advantage in these respects. On the other hand it occupied as much space as a solid 14-inch wall and was not so strong; thereafter, 2-inch by 14-inch timber was used exclusively. Another improvement was in the use of hangers or iron lugs spiked to the cribbing, instead of the oak cross-pieces which had been set into the cribbing, thereby weakening it, and which were often broken under the pull, and also were in the way in handling the pumps. The shaft was located 100 feet east of the fourth attempt. As a daily journal was kept by Mr. James Anderson, then engineer of the company, of all attempts after the third, and as this sinking was typical of the difficulties, the diary will be given unchanged and uncolored by the views of the writer, except for such slight additional words as are necessary for clearness:

August 9—Shoe arrived from Chicago; unloaded and put it together in place.

August 10—Sunk shoe down into the ground and moved trusses into place; sunk 4 feet through grade filling. Depth, 4 feet.

August 11—Got tower up and started sinking, 3 p.m.; sunk 4 feet through grade filling and soil. Depth, 8 feet.

August 12—Put in hangers and rods, and started buntons in east end; sunk 7 feet through yellow clay. Depth, 15 feet.

August 13—Buntons now in both ends and going in regular fashion; sunk 7 feet, through 4 feet yellow clay, 3 feet blue clay. Depth, 22 feet.

August 14—Some water; handled by barrels; amount of water, 3 gallons per minute; sunk 6 feet through blue clay. Depth, 28 feet.

August 15—No trouble; water 3 gallons per minute; sunk 5 feet through blue clay and gravel. Depth, 33 feet.

August 16—No trouble; water 3 gallons per minute; sunk 4 feet through muddy clay. Depth, 37 feet.

August 17—No trouble; water 3 gallons per minute; sunk 5 feet through blue clay. Depth, 42 feet.

August 18—Water came in fast at 9.30 p.m.; put in a No. 9 Blake pump; water 104 gallons per minute after tapping; sunk 5 feet through blue clay and sand. Depth, 47 feet.

August 19—No trouble; water 104 gallons per minute; sunk 4 feet through blue and yellow clay, sand and gravel. Depth, 51 feet.

August 20—Sand all around south side and one-half of east end; hard clay and gravel under the rest, causing rushes. We do not dig out below press plates; water averaged 90 gallons per minute; sunk 5 feet through clay, sand and gravel. Depth, 56 feet.

August 21—We bored 2-inch augur-holes to relieve pressure and prevent rushes; Did not do much good; drove spiles but rushes threw them out again; water averaged 104 gallons per minute; sunk 3 feet through clay, sand and gravel. Depth, 59 feet.

August 22—Caved clear to the surface at the east end; a crack in the curbing was caused by rushes below the last clamp; shaft swung 6 inches out of plumb, inclining to west; water averaged 104 gallons per minute; sunk 1½ feet through clay, sand and gravel. Depth, 60½ feet.

August 23—The material is getting soft all over, principally sand and gravel; the shoe sets square, and we also got the timbering levelled; water 140 gallons per minute; sunk 1½ feet through clay, sand and gravel. Depth, 62 feet.

August 24—Had to stop on account of shortage of suspending rods; put in a Deane pump in the west end; the trusses are pulled down about 1 foot; water, 140 gallons per minute; sunk none. Depth, 62 feet.

August 25—Have now good solid clay all around, except under the northeast corner, where it is sand as yet; water 140 gallons per minute; sunk 2½ feet through clay and sand. Depth, 64½ feet.

August 26—Rushes of sand and water occurred all day; water 140 gallons per minute; sunk 2½ feet through clay and sand. Depth, 67 feet.

August 27—Had a very bad rush of sand, filling about 8 feet up the shaft; trusses almost broke down; water averaged 140 gallons per minute; sunk none. Depth, 67 feet.

August 28—Cleaned out the rush and blocked with wood between timber and shoe in place of jack-screws; withdrew the pumps; started to tear down trusses; shaft filled with water.

August 29—Finished tearing down; got levelled up for new trusses.

August 30—Started to build up trusses and top works.

August 31—Finished them and started pumping out water in shaft.

September 1—Got the water all pumped out and shoe cleaned out ready for sinking; water still coming in at rate of 140 gallons.

September 2—Rushes of sand with the water all day; started a Nye pump in the caved-in shaft of the previous attempt, located about 50 feet away, to try to relieve the pressure of water; water 140 gallons per minute; sunk 1 foot through clay, gravel and sand. Depth, 68 feet.

September 3—Same as yesterday; sand running up from a hole in the northeast corner; lowered the water in the neighboring shaft to 85 feet from the surface, so it is 17 feet below bottom of present shaft, but without any effect in relieving from water; water averaged 140 gallons per minute; sunk 1½ feet through sandy clay and sand. Depth, 69½ feet.

September 4—Got through with the sand pocket at northeast corner, but as a consequence of the rushes of the past few days, a hole came to the surface, causing the upper part of the shaft to swing 2½ feet east; threw in bales of hay till it stopped running; then filled up with clay; water 140 gallons per minute; sunk 2 feet through sandy clay and sand. Depth, 71½ feet.

September 5—Got all the water cut off from below; what there is comes in through the timbering; water 140 gallons per minute; sunk 2½ feet through sandy clay with gravel pockets. Depth, 74 feet.

September 6—No trouble; water 108 gallons per minute; sunk 3 feet through blue clay. Depth, 77 feet.

September 7—No trouble; water 83 gallons per minute; sunk 3 feet through blue clay. Depth, 80 feet.

September 8—No trouble; lowered pumps and water in neighboring shaft 20 feet, making water 105 feet from surface; water 70 gallons per minute; sunk 2 feet through blue clay. Depth, 82 feet.

September 9—No trouble; water 70 gallons per minute; sunk 3 feet through blue clay. Depth, 85 feet.

September 10—No trouble; water 70 gallons per minute; sunk 3 feet through blue clay. Depth, 88 feet.

September 11—No trouble; water 83 gallons per minute; sunk 3½ feet through blue clay and sandy silt. Depth, 91½ feet.

September 12—No trouble; water 83 gallons per minute; sunk 3 feet through sandy silt. Depth, 94½ feet.

September 13—Very fine sand running in with the water; water 104 gallons per minute; sunk 2½ feet through sand, very fine. Depth, 97 feet.

September 14—Some small rushes at east end; lowered Nye pump in neighboring shaft 10 feet; water 104 gallons per minute; sunk 2 feet through sand and gravel. Depth, 99 feet.

September 15—Small rushes again on east side, and one on south side; had to split a boulder in the southwest corner; water 104 gallons per minute; sunk 2½ feet through sand, gravel, and clay. Depth 101½ feet.

September 16—No more rushes, but still pretty soft on east end, so we cannot dig below shoe; hard jacking; water 83 gallons per minute; sunk 2½ feet through cemented clay and gravel. Depth, 104 feet.

September 17—Hard now all over; cannot make any room for shoe, as sand above is so very fine that it washes down through the smallest cracks; water 83 gallons per minute; sunk 2½ feet through cemented clays and gravel. Depth, 106 feet.

FIG. 3
PLAN OF FINISHED "B" SHAFT.

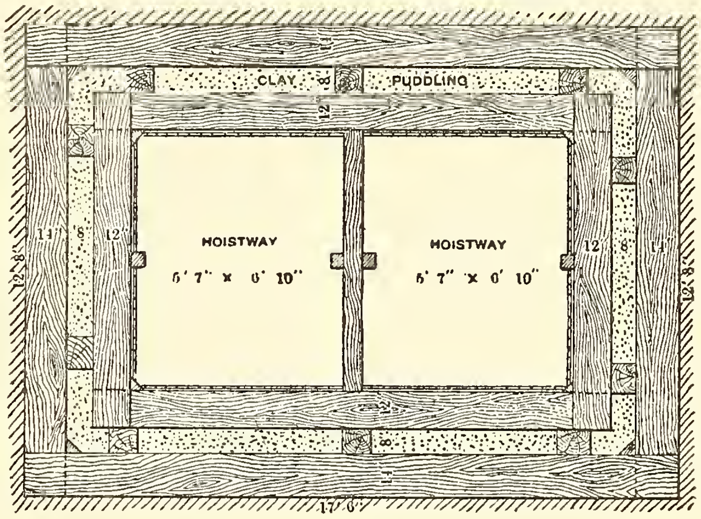
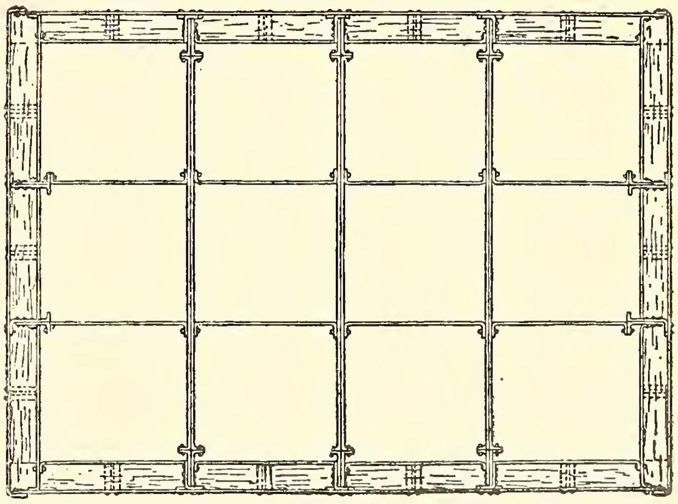


FIG. 4
GROUND PLAN OF SHOE.



September 18—Had a bad rush in the northwest corner, filling the shoe with fine sand, and causing at the surface a circular cave 100 feet north of shaft; water 83 gallons per minute; sunk 2 feet through sandy blue clay with boulders. Depth, 108 feet.

September 19—Had some large boulders, but the clay, while soft and sandy, is quite tough, and it seems probable that on jacking the shoe through it, the rushes will be cut off; water 70 gallons per minute; sunk 2 feet through sandy blue clay with boulders. Depth, 110 feet.

September 20—Lots of little boulders, but good jacking; water all cut off from the bottom; water 56 gallons per minute; sunk 4 feet through sandy blue clay with boulders. Depth, 114 feet.

September 21—Same condition as yesterday; water 56 gallons per minute; sunk 4 feet through sandy blue clay with boulders. Depth 118 feet.

September 22—No difficulties: water 42 gallons per minute; sunk 3½ feet through mucky clay. Depth, 121½ feet.

September 23—Changed Blake pump from east end to the centre and hung a Deane pump in east end; water 42 gallons per minute; sunk 3 feet through mucky clay. Depth, 124½ feet.

September 24—No difficulties; the mucky clay started to swell or heave up in bottom of shoe; water 42 gallons per minute; sunk 4½ feet through mucky clay. Depth, 129 feet.

September 25—No trouble; for some reason the neighboring fourth attempt shaft is making far more water than this shaft; water 42 gallons per minute; sunk 5½ feet through mucky clay. Depth, 134½ feet.

September 26—Put in another Blake pump in place of one removed for repairs; water 42 gallons per minute; sunk 5½ feet through mucky clay. Depth 140 feet.

September 27—No trouble; lowered Deane pumps; water 42 gallons per minute; sunk 4½ feet through 3 feet mucky clay and 1½ hard pan. Depth, 144½ feet.

September 28—Lowered Blake pump; broke lever; struck the large stream at 1.30 p.m.; running 500 gallons per minute; first rush brought about 10 barrels of sand; started the Deane pumps and kept the water down; water after rush 500 gallons per minute; sunk 2½ feet through sandy clay. Depth, 147 feet.

September 29—Lowered the west Deane; water now coming very clear; water 420 gallons per minute; sunk 2 feet through greenish clay. Depth, 149 feet.

September 30—Lowered both Deane pumps; the water all coming up as yet in the southwest corner and clear; water 350 gallons per minute; sunk 3 feet through clay with pockets of gravel. Depth, 152 feet.

October 1—Lowered east Deane and the Blake pumps; are now about the level of the water bed; water 350 gallons per minute; sunk 4 feet through sandy clay. Depth, 156 feet.

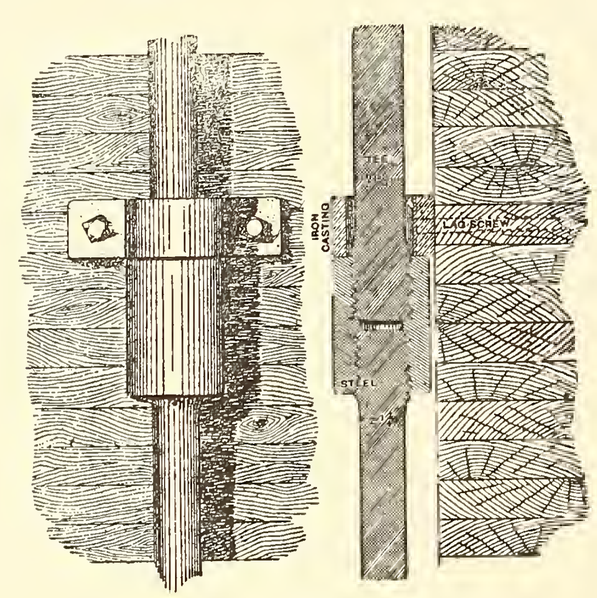
October 2—The discharge hose blew off the east Deane pump three times; at the same time the Blake pump played out, causing six hours delay; water clear and gravel not running; water 350 gallons per minute; sunk 3½ feet through gravel. Depth, 159½ feet.

October 3—The west Deane pump refuses to work, so we put in one more Blake pump; the water is coming in from all over; gravel has cement bands, sometimes running nearly across the whole bottom; water 350 gallons per minute; sunk 2½ feet through gravel. Depth, 162 feet.

October 4—The gravel being cemented together in cakes, it is very tough digging and jacking; the shaft is in good shape, no pulling; water 350 gallons per minute; sunk 3 feet through gravel. Depth, 165 feet.

October 5—Getting into the blue shale overlying the limestone; water 350 gallons per minute; sunk 3 feet through 2 feet of gravel and 1 foot of shale and gravel. Depth, 168 feet.

FIG. 5 FIG. 6



DETAIL OF ROD COUPLING

October 6—Got shoe on to rock: water cut off from under shoe; water 350 gallons per minute; sunk 2 feet through shale. Depth 170 feet.

October 7—Getting into rock, and some of compartments of shoe removed; pumps bothering; water 310 gallons per minute.

October 8—Getting more sump room in rock, and timbered down through shoe on to the rock; water 310 gallons per minute.

October 9—Got all the shoe braces out, and got farther down into rock; water 310 gallons per minute.

October 10—Got squared down through rock, and at 5.30 p.m. started inside cribbing and puddling from bottom; in this and the following shaft the inner cribbing was of 2 inch by 12 inch timber; laid flat; the space between the outer and inner cribing was 10 inches, which was filled with the puddling; water 310 gallons per minute; sunk during past four days 3 feet through limestone, practically finishing the difficult part of the shaft. Depth, 173 feet.

October 11 to 25—Occupied in building up inside cribbing and puddling between; water being allowed to fill up behind.

October 25—Tore down old top works and started permanent tower.

November 5—Started to pump the shaft out.

November 10—Got water out, but found puddling was not a success; the difficulty had been in getting it packed under running streams; caulking was now tried without effect, the shaft making 200 gallons of water per minute.

Nevertheless, sinking was resumed November 12th, and steadily progressed through the solid rock till coal was reached, except for two delays of a week each, when endeavors were make to shut out the water. Flooring was put on, but to no effect. Then the experiment was made of pumping in cement between the inner and outer cribbing, a method notably successful in the Croton aqueduct of New York city, to fill voids behind the brick lining; but here the conditions were such that it failed; the streams of water were too strong for the cement to set, and it washed out again.

After this no attempts were made to shut water out of the shaft, and except puddling, none in the later shafts. However, to keep the hoistways dry and also prevent the water from falling clear to the bottom of the shaft, water-rings were put in each shaft just below where the water enters, from which the water is piped to a pumping station on an upper seam. The water-rings are assisted in collecting the water by lining the shafts above them with flooring raised from the curbing by nailing on top of laths, thus keeping the water behind the flooring till it enters the ring.

Under the circumstances at Ladd, the writer believes this way is even better than if the shafts had been made water-tight. The water has so materially lessened since the first shafts were sunk as to cause belief that the bulk of it was held in the ground like an underground lake, and that this has now been drained, so that what is coming now is the seepage from the surface water-shed. The total quantity from the present three shafts averages this year (1894) about 135 gallons per minute. As the water is of excellent quality, it is used in the boiler plant and the town water system. While largely in excess of present needs, it will no doubt all be wanted in the future. Moreover, had the shafts been made tight, there would be the constant menace of a large body of water liable to be let down on any rupture of the shaft, a thing unlikely and yet always feared. As it is, there is no pressure whatever from the water, the shafts draining freely the natural flow of the strata.

Before the shaft last described, now known as "A" shaft, had reached the coal the sixth attempt or "B" shaft, was started on November 14, 1889, 50 feet west of the third attempt, now known as the air shaft, but which was temporarily abandoned at 125 feet. The latter shaft was now kept pumped out, materially helping in the sinking of "B" shaft, which made much less water than the previous shafts. Even when "B" shaft got below the third attempt there was not nearly so much water, for the ground seemed already largely drained after a year and a half of steady pumping. Accordingly "B" shaft was sunk much more rapidly than its predecessors. This was not entirely due to less water but partly to the experience gained by the sinkers in meeting the peculiar difficulties of the field and partly to the improvements made in the appliances. Among the latter was the plan of suspending the curbing from solid wooden triangles instead of the open Howe truss, which could not be designed to meet immensely varying strains, and so on several occasions had been crushed. Another improvement was in the shoe in making the plate braces so they could be easily removed on reaching the solid. They were made heavier but fewer in number, forming 12 compartments, instead of 15, as in "A" shaft. This shoe was highly satisfactory in all respects (see Figs. 3 and 4).

The only serious difficulty that "B" shaft encountered was when, at a depth of 50 feet, a hole came to the surface along side of the shaft at the east end, causing it to swing 6 inches out of plumb. The hole was promptly filled up with clay, which stopped the running, and no further trouble ensued. On December 31, 1889, the shoe was down on the solid rock.

The speed of sinking the fourth, fifth and sixth shafts is as follows:—

Fourth Shaft.—Started January 8, 1889. Reached rock June 30, 1889, a period of 174 days. Of these, 96 days were lost in delays, 78 days only being spent in sinking. Depth of shaft to rock, 162 feet. Average progress per working day, composed of three 8-hour shifts, 2.1 feet. Maximum rate of pumping, 640 gallons per minute.

Fifth Shaft "A."—Started August 10, 1889. Reached rock October 6, 1889, 58 days total, of which 7 were lost in delays and 51 spent in sinking. Depth of shaft to rock, 170 feet. Average progress per working day, 3.3 feet. Maximum rate of pumping, 500 gallons per minute.

Sixth Shaft "B."—Started November 15, 1889. Reached rock December 31, 1889. Total, 47 days, of which but two were lost in delays; 45 were spent in sinking. Depth of shaft to rock, 160 feet. Average progress per working day, 3.6 feet. Maximum rate of pumping, 350 gallons per minute.

There was no detailed record kept of the third or air shaft, but after getting "B" shaft down, sinking was resumed from where it had stopped over a year before on account of the lightness of the shoe, and now that "B" shaft was draining the water there was no trouble in getting the air shaft down. Thus three of the original six attempts were finally successful; and all the shafts in which the shoe was used succeeded in reaching rock.

I will now give a description of the details of the shoe, method of hanging the curbing, etc., as finally developed and used in sinking "B" shaft.

Beginning at the top, there is first in order a platform of 2-inch plank laid on the surface about the shaft, and covering an area 30 by 46 feet; on top of these, running across them and parallel to the sides of the shaft are 60-pound steel rails. These form the foundation of the four solid wooden triangles which carry the weight of the curbing not sustained by the friction of the ground. Each triangle is made of 8 pieces of 12-inch by 12-inch timber, the bottom one 48 feet long, the next 4 feet shorter, and so on to the top one, which is 20 feet long. The triangles run across on top of the rails and the narrow way of the shaft. On them and across them rest two 16-inch by 16-inch timbers 20 feet long. These are nearly over the side walls of the shaft; through them pass the 8 rods which sustain the curbing, four to each side or timber, huge washers under each rod head distribute the strain over the timber, which in turn distributes it to the triangles. The whole forms an almost rigid structure, so that when subsidence comes, everything goes down at the same time. The hanging rods are steel, and made in 10-foot lengths, the ends upset or thickened so that screw-couplings are made without weakening. The upper lengths are 2½ inches in diameter, every three lengths down the size decreases ¼ of an inch, so that the bottom lengths are 1¾ inches in diameter. The support to the curbing is, as finally adopted, an iron lug placed under the screw-coupling piece at each joint and spiked to the cribbing.

The shoe as finally designed and used in "B" shaft was 12 feet 8 inches by 17 feet 6 inches inside measure, built of ¾-inch steel plate, the sides 4 feet deep, of which the upper 16 inches was the shield embracing the bottom of the curbing. The lower part of the shoe was divided into 12 compartments by three transvere braces of ¾-inch plate, doubled, 22 inches deep, and two longitudinal lines of braces, of ¾-inch plate, 16 inches deep. Around the inside of the shoe 12 inches from the bottom runs a shelf 9 inches wide of ¾-inch plate, braced below with brackets, and with a 2-inch ledge in front. This forms the press-plate on which are placed the jack-screws to force down the shoe; directly above is the shaft-cribbing against which the jack-screws bear. Although the shoe itself weighs 8 tons, the jacking was often very hard. The mode of operating is to apply the jack-screws till the shoe has been forced down from 2 to 10 inches, depending on the ground, never more than 10 inches, which leaves but 6 inches of shield lapping the cribbing. Then the shoe is levelled carefully, the jack-screws removed, the 2-inch cribbing-plank put in place and spiked upward to the previous course. It is further tied, till the next hangers are put on, by boards nailed up and down the curbing. The cribbing is arranged with butting-joints, the planks alternately overlapping, a simple and a very strong way with plank laid flat. It is further strengthened by triangular corner-strips.

Two-inch planks are used for the cribbing instead of thicker timber, because more easily handled in the cramped space at the bottom of the shaft, and they are little less strong for the same thickness of wall. After as many courses of cribbing are in as the space allows for, frequently in bad ground only one, the jack-screws are replaced and the operation repeated. Separate plate-covers were provided for the compartments of the shaft "B" shoe, but it was found that the rushes of sand could be kept down if the excavation were not carried below the press-plates; and as the covers would hamper the work they were not used. They were kept at hand, however, the idea being, that when dangerous ground was expected, all the compartments except one or two would be closed.

Meantime the excavation and pumping goes on according to circumstances, and with the customary appliances.

To provide for supporting the shoes when a very soft spot is reached, chains, one in each corner, pass around the braces and hook to the hanging rods. An improved detail would be the insertion of a long turn-buckle at the lower end of each chain, fastened by clevis to a brace. At Ladd full weight was never thrown on the chains, the shoe always binding on some part; in soft ground, where there was danger of rushes, excavation was never advanced below the bottom of the shoe. There were usually three pumps hanging in the shaft, one in each compartment. The vertical Deane plunger pump with a 4-inch delivery was the favored type. The pumps were hung by hemp cables from capstans at the top, so as to be readily raised and lowered, the steam and water connections to the pipe lines being made with flexible hose.

In conclusion, I will say that I think this system of sinking shafts well fills the gap in deep shaft sinking, between the solid ground systems and the true drop shaft system. For instance, here at Ladd, the first failed in two hard-pushed attempts, the second also failed after a shorter trial, but the boulders and hard ground met deeper, fully showed how impracticable it would have been. Of other known systems, the pneumatic is out of the question for over 70 or 80 feet of water pressure, and while the Poetsch freezing system alone seems applicable to nearly all circumstances, its present great cost makes it prohibitive except in extraordinary cases. On this account, leaving the freezing system out of consideration, where there is a ground filled with water and over 80 feet in thickness to be pierced, too soft for solid ground systems and yet containing boulders, cemented material, or some hard ground which would prevent any kind of a drop shaft, the method described in this paper is sigularly well adapted.

Dominion Railway Subsidies

To Canadian Coal Companies, 1893.

Boston and Nova Scotia Coal Company.—By the Dominion Subsidy Act, 57-58 Vic., ch. 4, 1894, a subsidy to this company limited to $113,600 (in lieu of one previously granted in 1892) was authorized for the construction of 35½ miles of railway from a point on the Cape Breton Railway at or near Orangedale to Broad Cove, on the western side of the Island, and under date the 16th of November, 1894, a contract was entered into with the company for the work subsidized, the date for completion being fixed as the 1st August, 1896.

No payments have been made up to the 31st December, 1894.

Dominion Coal Company.—By the Subsidy Act, 55-56 Vic., ch. 5 (1892), a subsidy, limited to $89,600, was authorized for 28 miles of a railwny to complete connection between Sydney and Louisburg, Cape Breton.

On the 26th of January, 1894, a contract was entered into with the above company for the work from Bridgeport to Louisburg Harbor. The first 10 miles section from Bridgeport has been completed, but no payment on subsidy account has been made up to the 31st of December, 1894.

Nova Scotia Steel Company, Ltd.—By the Subsidy Act, 55-56 Vic., ch. 5, the grant of assistance to the above company for 12½ miles of railway from Eureka Junction on the Intercolonial Railway to a point at or near Sunnybræ, including a branch line to the charcoal iron furnace at Bridgeville, was authorized, the limit of aid being $40,000.

Under date of the 23rd of November, 1892, the company were admitted to contract for this work.

During the fiscal year there was paid $5,454.16, making the total payments up to the 31st of December, 1894, $38,400. For the previous year $38,400 was paid.

Medicine Hat Railway and Coal Company.—By the Act 50-51 Vic., ch. 23 (1887), authority was given for the grant to the above company of Dominion lands to the extent of 6,400 acres per mile, for a railway from a point at or near Medicine Hat, on the line of the Canadian Pacific Railway, to the coal fields in or near Townships Nos. 12 and 13, Range 6, west of the 4th Principal Meridian, a distance of about 8 miles.

By an Order in Council of the 6th July, 1887, the grant was made to the company accordingly, it being provided that the road should be completed and in operation by the 31st of December, 1888.

By an Order in Council of the 24th of January, 1889, approval was given to a draft of a formal contact with the company, and an extension of time to the 2nd of June, 1890, was granted for completion of the road. A contract was signed on the 14th of February, 1890, for this work.

By the special Act 53-55 Vic., ch. 79 (1891), the charter of the company was revived and its powers were extended, and by the special Act 57-58 Vic., ch. 80, the time limit for completion was further extended to the 1st of January, 1898.

Alberta Railway and Coal Co., Ltd. (property purchased from the North-western Coal and Navigation Co., Ltd.)—Dominion lands to an extent not exceeding 3,800 acres for each mile of the company's railway, from Medicine Hat to the coal banks on the Belly River, about 110 miles; also lands to an extent not exceeding 3,840 acres for each mile of the company's railway from Lethbridge to the Crow's Nest Pass, a distance of about 100 miles. A grant not exceeding 2,600 acres for each mile of the company's railway from Dunmore station, on the C.P.R., to Lethbridge, a distance of 109½ miles, on condition of a standard gauge; and also 6,400 acres for each mile from Lethbridge to the International Boundary, a distance of 50 miles.

Red Deer Valley Railway and Coal Co.—$6,400 for each mile from Cheadle Station on the C. P. R., to the terminus of the proposed railway at a point in or near Township 29, Range 23, west of the 4th meridian.

Dominion Lime Co.—For seven miles of their railway from a point on the Quebec Central Railway, in the Township of Dudswell, to the Dudswell lime quarries, a subsidy not exceeding $3,200 per mile, or $22,400.

Cumberland Railway and Coal Co.—For fourteen miles of their railway from a point on the Springhill and Parrsboro' railway, near Springhill, to a point on the railway between Oxford and New Glasgow, near Oxford Village, a subsidy not exceeding $3,200 per mile, not exceeding in the whole $44,800.

Londonderry Iron Co. Ltd.—(Grant to Steel Co. of Canada)—A grant as subsidy (road to be first laid with new steel 56 lb. rails and after an Order-in-Council has been passed authorizing their transfer to the company) of 597 tons of used iron rails and fastenings loaned to the company, which rails and fastenings stand in the Public Accounts as an asset for $11,964.66.

Canada Coal and Railway Co.—(Grant to Joggins Railway)—For one and a quarter miles of their railway ending from the southern end of the portion subsidized by the Act 49 Vic., chap. 10, to the wharfs, not exceeding $3,200 per mile, nor exceeding $4,000.

Railway Earnings 1893-4.

(Fiscal Year ended 30th June.)

Company.	Gross Earnings.	Net Earnings.	Mileage.	Earn. per train Mile.
Alberta Railway and Coal Co	$127,348 53	$49,688 35	64.62	$107 38
Cumberland Railway and Coal Co.	123,413 31	64,794 95	32.00	19 62
Canada Coals and Rail Co.......	20,350 90	6,400 77	12.00	203 50
New Glasgow Iron Coal & Ry. Co	28,638 80	14,663 78	12.50	177 33

Canadian Companies

Ontario Iron and Steel Co. Ltd.—This company is seeking incorporation under Ontario statutes, to manufacture pig iron, refined iron, steel and manganese, and nickel steel or other alloy of steel by any process; and the casting and manufacturing of such products into ingots, billets, structural forms, rails, plates and bars, rolling stock castings and forgings, corrugated and galvanized plate; to manufacture wire and wire cables; to construct iron and steel ships and vessels, bridges and buildings; and to manufacture coke or any form of prepared fuel; to buy or sell all necessary materials and patent rights for any of the said manufactures, etc. Authorized capital $600,000, in shares of $100. Directors, Grant E. Hamilton, New York; G. W. Caulfield, Youngston, Ohio; and H. G. Hamilton, Youngston, Ohio. The chief place of business is to be at Kingston, Ont. The daily capacity of the blast furnace is to be 285,000 pounds of pig iron, that of the steel plant 80,000 pounds of steel blooms, that of the blooming or billet mill 80,000 pounds of steel billet, and that of the rolling mill 80,000 pounds of steel or iron bars. This amount of product is expected to require the labour of from 300 to 500 hands at the works. Kingston is to provide funds to the extent of $250,000, secured by a first mortgrge on plant and stock, and none of the money is to be paid until all the material is on the ground for the erection of the furnace, and then only one-fifth. Until its loan is repaid the municipality is to take all government bounties earned on pig iron, steel billets, and bars, which are expected to amount to $100,000 a year. A joint committee of the Kingston City Council and Board of Trade made a report in favor of the proposal, and recommended that the company be required to furnish information satisfactory to engineering and financial experts appointed by the city, a report which the City Council adopted.

Finch Mining Co., Ltd., has been registered under the British Columbia (foreign) Companies Act, with an authorized capital of $6,000, in shares of $50 each. Head office, Pittsburg, Pa.

Belmont Bessemer Ore Co.—The annual general meeting of shareholders was held at Toronto on 23rd instant.

Cariboo Hydraulic Mining Co. Ltd.—Advices from Cariboo, B.C., up to May 10th, state that the Cariboo Hydraulic Mining Co. has now everything in readiness to start hydraulic operations, working continuously with three shifts of men. Cold weather since the 4th instant had reduced the supply of water and caused some interruption in operations, but since the mail left the weather has been warmer and the supply of water should be ample.

B. C. Terra Cotta Company, Ltd.—Notice is given that by an order made by the Supreme Court of British Columbia, dated the 9th day of April, 1895, it was ordered that this company should be wound up, under the provisions of the "Winding Up Act," and by a further order of the said court, dated the 10th day of April, 1895, it was ordered that A. F. Barham be provisional liquidator of the affairs of the said company. A meeting of creditors will be held with a view to carrying on the works of the company.

Tilbury Peninsular Oil and Gas Company is seeking incorporation under Ontario Statutes to search for oil, natural gas, etc. The operations of the company are to be carried on in the counties of Kent and Essex, in Ontario, and the chief place of business is to be at the village of Tilbury Centre, in the county of Kent. Authorized capital, $20,000, in shares of $50.00. The directors are: W. C. Crawford, C. C. Kippen, F. M. Scarff, P. E. Gurd, and Nathaniel Mills, all of the village of Tilbury Centre, Ont.

Le Roi Mining and Smelting Company.—This company has ordered a new hoisting plant of a capacity of 100 tons, and the boilers will be 100 h.p. The present hoist was put in before the Le Roi had developed its large ore bodies and has become inadequate to the demands of the mine. The company has now more than 1,000 tons of ore on the dump, says the Spokane *Review*. Superintendent George Bent says the present ore accumulations, together with the ore shipped during the winter and spring, were taken out in development work on the 350-ft. level on the east and west drifts, one of which is in about 110 ft. and the other 120 ft. The company is also equipping its property with electric lights.

The Lillooet, Fraser River and Cariboo Gold Fields, Ltd.—The following report has been issued from the London office of this company: "The following cable has been received from Mr. Frank S. Barnard, M.P., chairman of the Lillooet, Fraser River and Cariboo Gold Fields, Ltd.:—'Hughes reports greatly impressed with what he terms marvellous gold deposit in gravel. Is sinking shafts and prospecting vigorously and pushing forward development.' The secretary adds: 'Mr. Hughes has been appointed the company's mining superintendent and he has been for years one of the most successful and experienced mining engineers known in California.'"

Northern Gold Company.—Pursuant to a judgment of the High Court of Justice, Common Pleas Division, made in a cause of Phillip St. Lawrence against the Northern Gold Company and others, the creditors of the Northern Gold Company are, on or before the 2nd day of July, 1895, to send by post, prepaid, to A. C. Boyce, Rat Portage, Ontario, solicitor for the plaintiff, their Christian and surnames, addresses and descriptions, the full particulars of their claims, the statement of their accounts, the nature of the security held by them, if any, together with an affidavit verifying the claim, or in default thereof they will be peremptorily excluded from the benefit of the said judgment.

General Phosphate Corporation.—An adjourned public inquiry with reference to the promotion of this company and the conduct of its business was held last month before Mr. Registrar Hood, at Bankruptcy Buildings, Carey Street, Lincoln's Inn, London, Eng. The company was registered on June 13th, 1890, with a nominal capital of £1,000,000, and was formed for the purpose of acquiring and working phosphate properties, and engaging in undertakings connected therewith. Upon the last occasion Mr. Knud Sando stated that he had received commissions amounting to £16,000 from the vendors of properties purchased by the corporation. He asserted that the directors were aware of this fact, although they never inquired what sum he obtained, nor did he inform them of it.

Mr. Knud Sando was again called, and stated that in January, 1890, he entered into a contract or option for the purchase from Mr. Stewart of the "High Falls" group of phosphate properties. The purchase price was originally £54,000, but it was ultimately reduced to £40,000. Witness informed Mr. Stewart that if the price was reduced to £40,000 he would be prepared to submit the property to the board for their consideration. He learned that Mr. Stewart would be satisfied if he received £29,000, and it was subsequently agreed between them that witness should receive any amount paid to Mr. Stewart above the sum mentioned. The property being purchased for £40,000, witness was entitled to £11,000, which was satisfied by a mortgage. In connection with the "Ross Mountain group," witness received a letter from an agent promising him £5,000 if he was instrumental in selling the property. The corporation eventually purchased it for £55,000, and he received his commission on the sale. The sum of £1,000, which he paid to Mr. Davidson, was in respect of private services rendered in Canada. He denied that he had promised any remuneration to an expert who had furnished reports upon the properties to the corporation.

Mr. H. Mallaby-Deeley, a director of the company, was next called, and in reply to the official receiver stated that the matter was introduced to his notice in December, 1889. Mr. Sando sent him a commission note promising him £1,000 and twenty founders' shares if he succeeded in obtaining three directors for the proposed phosphate trust. The original idea was to form a company to acquire certain phosphate properties at the price of about £600,000, but upon mentioning the matter to several gentlemen, witness found that he could not obtain directors of sufficient standing and importance to carry out a scheme of such magnitude, owing to the fact that they would be bound to purchase certain properties. He informed Sando of this, and the scheme was ultimately altered so as to leave the directors entirely unfettered in their selection of properties. The commission note referred to was then destroyed by witness. Questioned as to what took place with reference to the qualification of the directors, witness said that Sir James Whitehead asked him whether Sando was giving him anything for the work he was doing. Witness said that he had no arrangements with regard to the corporation, but that Sando had agreed to qualify him as a director, and that he had agreed ta qualify any director whom witness obtained. Sir James Whitehead expressed his disapproval of this course, and mentioned the matter at the next board meeting, when Sando was called into the room and informed that if he offered to qualify any of the directors they would not accept his offer. After the formation of the corporation Sando gave him twenty founders' shares for services which he had rendered in connection with a colonization company which Sando was about to form in British Columbia. Witness had obtained introductions to members of parliament who could assist in the scheme, and received the shares as remuneration on that account. Sando subsequently offered to purchose the shares from him for £1,000, but, as a matter of fact, the witness had only received £550.

Mr. H. Mallaby Deeley was again examined by the Official Receiver. He stated that on August 15, 1890, the board considered the purchase of properties, and a committee, consisting of Sir G. Baden-Powell and witness, was appointed to negotiate with Mr. Stewart for the purchase of the "High Falls" group, situated in the townships of Portland West and Bowman, in the Province of Quebec, at a price not exceeding £40,000. It was subsequently agreed that the property should be purchased for that sum. In the agreement for purchase it was directed that "Mr. Attwood, or some other person to be approved by the vendor," should report upon the property. The directors discussed the question of appointing an expert, and decided that they could not do better than appoint Mr. Attwood. He denied that it was part of the bargain that this expert should be appointed. The directors obtained the services of those experts upon whose opinions they considered they could rely. In 1891 the Company entered into a fresh speculation, known as the "North Star" scheme. The matter was introduced to the board by Mr. H. S. Foster, M. P., and the scheme had for its obiect the acquisition of the North Star and Washington mines, situate near the High Falls property, with a lease of certain phosphate mills in the neighborhood. It appeared that Mr. Lainson Wills had made a report upon the property, from which it seemed that the productive power of the North Star mine had greatly fallen off. In April, 1891, the heads of an agreement were signed under which the Company and the London and Colonial Finance Corporation, Limited, were to combine in order to carry out the scheme. The directors of the two companies were not satisfied with the report refered to, and Mr. Attwood was appointed to inspect the property. His report was satisfactory, and the Board considered that they were justified in entering upon the transaction. Witness was paesent when 117 founders' shares were allotted Mr. Sando.

The Official Receiver: I think you will agree that Mr. Sando was taking upon himself a very heavy responsibility under this allotment?

Witness said that Mr. Sando was to be relieved as applications for founders' shares were received. He was ultimately relieved of fifty-nine shares.

The Official Receiver: That leaves a responsibility for £29,000.

Witness said that would be so if all the calls upon the shares were made. The directors were not aware at the time that Mr. Sando was almost without means, but on the contrary, they knew that he had paid the registration fees, although witness did not know that the money had been borrowed for that purpose. The directors had no knowledge as to Mr. Sando's means, and made no inquiry upon the subject. Towards the end of 1890 the Company was in very low water so far as finances were concerned. A circular was issued in December of that year inviting further subscriptions for shares. The appeal failed, and no further attempt was made to obtain money by means of shares. The directors then turned to other quarters, and began seriously to think about a debenture issue. Eventually a debenture issue was arranged for £100,000, at 6 per cent. interest, and a commission of 15 per cent.

The Official Receiver: How much did the Company receive out of the £100,000?

Witness said that £5,400 in cash was received, and there was a right to call for a further £14,000, and the mortgages on the properties were paid off. The Company was in need of money, and it was necessary to pay off the mortgages before money could be raised.

The Official Receiver: I put it to you that if you had not spent £95,000 in the purchase of properties, with a paid-up capital of £45,000 only, you need not have raised this money?

Witness said that he could not accept this view of the matter. If the shares had been fully paid up, there would have been sufficient to carry on the mines without raising money on debentures.

Mr. Butcher next examined the witness, who stated that he was aware that Mr. Sando had entered into "options" with the original vendors of properties. He did not call the commissions which Mr. Sando was receiving "secret profits."

Mr. Butcher: Are you aware that promotors are not allowed by law to obtain secret profits out of a company?

Witness: I thought that a promoter could get as much as he possibly could out of a company. (Laughter.)

Mr. Butcher: I am afraid that it is a principle they sometimes act upon. (Laughter.)

Examined by Mr. Cock, Q. C., the witness stated that Sir James Whitehead resigned his seat on the board before any agreement had been entered into for the purchase of properties, and previously to the capital of the Company being dealt with in any way. At the time the directors allotted the founders' shares to Mr. Sando they did not intend to call up more than £2 per share. The directors fully believed that he would be in a position to provide the money for the shares. Sir James Whitehead resigned his position on the board on account of ill-health.

By Mr. Ridley: The properties purchased by the board were chosen out of a great number submitted to them, and he was not aware of any further precautions that could have been taken by the board to satisfy themselves as to the value of the properties.

The inquiry terminated shortly afterwards.

Guelph Norway Iron and Steel Company is applying for Ontario charter to manufacture iron and steel from ores and from scrap iron and steel, and to manufacture iron and steel into any products of iron and steel, etc. Head office: Guelph, Ont. Authorized capital, $80,000, in shares of $100.00. Directors: James Watt, Christian Kloepfer, Frank Dowler, A. R. Woodyat, and J. E. McElderry.

North American Graphite and Mining Co., Ltd.—This company is reported to have acquired the Dickson graphite property in the Buckingham district and work is to proceed forthwith. Mr. H. P. H. Brumell, for a number of years assistant in the mining division of the Geological Survey of Canada, has resigned and will assume the management of the company's operations.

Kootenay Gold, Silver and Copper Mining Company, Ltd.—Registered at Victoria, B.C., 22nd April, 1895. Authorized capital, $100,000, in shares of $25.00 each. Directors: Charles J. Mitchell, Thos. R. Morrow, and George D. Scott. Head office: Vancouver, B.C. Mining to be carried on in the Kootenay district, Province of British Columbia.

Kootenai Hydraulic Mining Co., Ltd., is applying for charter of incorporation to acquire and operate mineral claims in the Pend d'Orielle River district, British Columbia. Head office: Rochester, N.Y. Authorized capital, $500,000.

Vancouver Gold and Silver Exploration and Concessions Company, Ltd.—Authorized capital, $500,000, in shares of $100. Directors: Johann Wulffshorn, R. G. Tatlow, A. Williams, Chas. Stinson, Robert Hamilton, J. W. Campion. Head office: Vancouver, B.C. Formed to operate in British Columbia.

Horsefly Hydranlic Mining Co. Ltd.—At the works of the company on the Horsefly River, Cariboo, B.C., the most interesting event since our last report has been the successful blasting operations which have been carried out to loosen up the cement gravel deposits. On the 1st ult., a blast was fired in the bank at the new pit, 160 kegs of powder being used. The ground was well broken up for a distance of 80 feet, and the result was all that could be wished. On the 8th ult., the larger blast was fired in the old bank. A drift had been run in the bank, at a depth of between 200 and 300 feet from the top of the bank, to a distance of 1,800 feet, where drifts were made right and left in the shape of a T. In this the enormous quantity of 40,000 pounds of powder had been placed for the blast. This was fired by electricity and the operation was completely successful. The surface of the immense mass was raised about 6 feet and then fell back into its former position and nothing was disturbed. So nicely had the calculation been made as to the requisite strength of the blast that not a stone flew 100 feet away. Hydraulic operations on the gravel will be greatly facilitated by the loosening up of the bank by this blast. The water was to be turned on on the 11th ult., and by this time it is probable that work is being carried on in full force. It is expected that the first clean up for this season at both the Cariboo and Horsefly claims will take place before the end of June and it is anticipated that the results will be very satisfactory to the shareholders. Should the water supply continue to be sufficient for full operations, the season's work on these two properties should give such returns as will show the immense possibilities for successful hydraulic mining that are still to be found in the Cariboo district.

Ottawa Hydraulic Mining and Milling Co. Ltd., applies for B.C. charter to acquire by purchase the lease of the ground situate at Boston Bar, on the east side of the Fraser River, containing 64 acres, more or less, which said lease was made by Mr. G. C. Tunstall, Gold Commissioner, to Edmund Alexander Watson on the 5th day of June, 1893, for the sum of one thousand dollars in cash, and for the purpose of acquiring by purchase or otherwise of any mines or mining property in British Columbia, whether alluvial or mineral, and for the purpose of working any such mines or claims in the most approved and workmanlike manner, and for the purpose of erecting quartz-mills and smelters and saw mills, and any other known appliance for the purpose of working any mines or ores obtained therefrom, and for the purpose of acquiring water and water-rights for the purpose of working any claims or property that may be acquired by the company. Authorized capital, $250,000, in shares of $5. Directors, Lt.-Col. Joshua Wright, North Bend, Yale District, B.C.; Capt. M. N. Garland, North Bend, B.C.; F. W. Valleau, North Bend. Mines office, North Bend, Yale District, B.C.

Danville Slate and Asbestos Co. Ltd.—This company has purchased the Jeffrey Asbestos Mine at Danville, Que., at a price, so it is reported, of $150,000.

Dominion Coal Co. Ltd.—In his report to the Local Government, Dr. Martin Murphy, Provincial Engineer, has the following to say of this company's railway from Bridgeport to Louisburg. "The road has been constructed, so far, in a more permanent and serviceable manner than the contract calls for. The gradients and curvature have been reduced at considerable expense, so as to lessen the cost of transport. The cuttings are taken out to a width of 22 feet at formation level; the embankments are 16 feet wide. The permanent way is much heavier; rails are 80 lbs. per lineal yard, the contract being for rails 56 lbs. per yard. Servis tie plates of steel, weighing with fastenings, 100 lbs., connect the joints. The drainage a very important feature, is well provided for, by sideor 'off-take' ditches thus diverting the surface water from the slopes of cuttings and embankments and conveying it to the streams passing through the culverts and bridge openings. The culverts and bridge superstructure, speaking generally, are of a superior class of masonry. The bridge and trestle superstructure are of steel and are in strength and construction, built according to the progress of the time, heavier and stronger than the class of such work generally erected to carry lighter rolling stock. They are built according to the requirements of the Federal Government specifications. The class and character of the work throughout the ten miles now opened for traffic, is superior to any I have inspected in this country. The station building at Bridgeport and the station house, engine house, repair shop and freight shed, at Glace Bay are built on concrete foundation walls and are unusually large and commodious."

Nova Scotia Steel Co., Ltd.—Respecting the construction of this company's railway, Dr. Murphy, in his annual report, says:—"Eureka to Sunny Brae, 12½ miles, leaves the Pictou Branch of the Intercolonial Railway at Ferrona Junction, crosses the west branch of the East River to Ferrona, where the smelting works of the company are located, and runs up the valley of the East Branch to Sunny Brae. The first 10½ miles was opened for traffic to the public on the 1st of July, 1892, and the remainder is in operation since November following. The company applied for payment of subsidy according to the contract with the Provincial Government—(see Appendix 17, p. 15, Journals of the House of Assembly, 1891), the conditions being:—

(*a*.) "They shall have completed, equipped and put in operation the said line of railway."

(*b*.) "They shall have paid, or cause to be paid, the wages due to the workmen employed, and all charges for materials supplied for the construction of the said railway."

(*c*.) "They shall have constructed, completed and put in operation at some place within the County of Pictou, a blast furnace for the smelting of iron ores."

(*d*.) "They shall have established to the satisfaction of the Governor-in-Council, that they have *bona fide* expended in cash in the construction of said railway and blast furnace a sum of $400,000."

All these conditions the company have fulfilled, and have carried them into effect before the time stipulated for completion, viz., the 31st day of December, 1892, and further they have constructed the line of railway in accordance with the specification and all other conditions of contract.

After receiving formal instructions to examine the contract, to inspect the works, and to report accordingly, I made an inspection of the line on the 22nd May, 1893, reported the work satisfactory, but not quite finished, and recommended a payment of thirty-five thousand dollars on account. The subvention account stands thus:—

Twelve and a-half miles of railway, at $3,200 per mile....	$40,000
Payment recommended on account........................	35,000
Balance of subsidy remaining due on September 30th, 1893.	$5,000

The foregoing conditions have been complied with, the railway has been completed and the balance of subsidy paid on a certificate to that effect given on the 16th day of December, 1893."

The Mica Market.

During the past two months the demand for amber mica has quietly increased, and prices for large lots have advanced, owing to increased cost of mining. The principal demand has been for thumb-trimmed and rough-split, while some lots of trimmed have been sold. One dealer to keep up the supply of trimmed has been culling dumps of several Templeton mines and trimming all that would cut 1 x 3 inches. Three mines are at present in operation, the output of two being steady, the work being on veins, while in one the mica is in pockets with an inclination to phosphate shortly. All the mica mined finds a ready sale, principally to the United States, the consumption in Canada being small but increasing. Several sample lots have been sent to England, reports on which are favorable. There is a strong hope that the demand from England is on the increase.

The Care of Mine Pumps.

By J. Clarence Stine, Osceola Mills, Pa.

Acidulated mine water is probably as great a source of trouble and expense at mines drained by steam pumps as any other natural feature of a mine.

The best way to counteract its destructive effects on pumps is to use gun metal or some other similar composition for the water ends of the pumps. Owing to its first cost, gun metal is not often used, and besides there are some waters so acidulated as to attack it and similar compositions nearly as savagely as they do good hard iron. The writer has seen gun metal rendered soft and spongy in less than a month's time, has known one inch iron bolts to be eaten to the thickness of a lead pencil in three days, and has seen 3 inch iron pipe eaten so thin that a full length of it could easily be carried in one hand.

I was recently shown the water end of a pump, which owing to a sudden change in the water from "sweet" to bad, had been utterly ruined in less than a month's time. Every mine superintendent shouln keep on hand duplicate parts, liable to wear or corrosion of all pumps, as a breakdown of a few hours duration may, at times, cause irreparable damage. Aside from the parts subjected to wear by friction, the piece in double acting pumps likely to wear out first is the wall or partition between the bottom valves. This is caused by the water being discharged, from the valves nearest to it, against both sides, and, as the valves are usually located nearer the partition than the outside shell, the current must strike it with considerable force. Aside from this, it is attacked on both sides, and must, therefore wear twice as fast as the shell. When this wall is eaten through, the pump will do no work, as the water is forced from one side of the plunger to the other side. A method sometimes used in repairing this, is to melt and run sufficient Babbitt metal, or similar composition, into and around the wall to close the part eaten. This is only a makeshift at best, and a poor one. When hot the Babbitt metal lies close to the wall, and when cold it shrinks from it, allowing space enough for small quantities of water to pass through. This water gradually enlarges the passage way, and in a short time the pump is in a worse condition than before.

A method by which I have repaired several pumps, and which is original, as far as I know, is as follows: Drill down the top and bottom of the partition its full length. Then with a chisel chip out the entire partition, and chip both sides until sufficient breadth is obtained for a good joint. When the pump is a solid casting allow about a quarter of an inch taper so as to more easily fit the new partition. Then with a cape chisel about ⅜ of an inch wide cut a groove in each side of the same depth. These grooves should be carefully filed, and be made as nearly parallel with each other as possible. The success of the entire job depends on the fitting. Next is the new partition, which should be made of gun metal or a similar composition. Make a pattern, allowing enough for filling and shrinkage. (Brass shrinks about ⅛ of an inch in ten.) After the piece is cast it should be fitted into the grooves so as to make a perfect joint on all sides. Unless this is done the work will be a failure. When finished the bearing parts should be given a good coating of white lead and oil, and the piece be driven tightly into its place. If all the directions are carefully carried out, the new piece will outwear any other part of the pump. Of course it is better to get the casting at a foundry, but if there is no foundry handy the whole job can be done at the mine by any person having some knowledge of machinery. In this case it is better to make the casting first. The metal can be melted in an ordinary graphite crucible in the blacksmith's fire. With the exception of the casting, the work requires only such tools as are to be found at every well managed mine. All the tools necessary are a ratchet, chisels, hammer, drill and a few files. I have been called on to repair pumps in this manner several times and have never failed, and all pumps so repaired are at work, and, as far as can be seen, they are as good as new. One of them, a Cameron pump, has been running about two years, and to all appearances is good for many more. Another, a Blake pump, had been "doctored" in every conceivable way, but without success. After repairing it, as above described, it has run for several months and is giving excellent sntisfaction. The bore of the cylinders of the pumps repaired, was, as nearly as I can remember, from 8 to 12 inches.—*Colliery Engineer.*

Rope Driving.—One of the most eminent engineers Mr. Nasmyth, favors the driving of machinery with cotton ropes in place of leather bands. As a result of many years' experience and close observation, he states that for heavy main drives it is both more economical and effective to use a series of ropes working in separate grooves, and in regard to the objection made to this system—that of the ropes extending unevenly and becoming variable in size, causing a portion of them to be more deeply in the grooves than others—he states that ropes are now made with such nicety and are fitted into grooves with such exactness, that little trouble from this source is experienced. In giving his reasons for thus favoring cotton as the material of which the ropes should be made, Mr. Nasmyth argues that strength alone should not be considered, but flexibility and elasticity, which properties pertain to ropes of cotton more than to those of any other material yet employed.

CANADIAN MINING INSTITUTE.

A MEETING of Delegates from the various Canadian Mining Organizations wil be held in the Chateau Frontenac, Quebec, on Friday evening, 28th June at eight o'clock, for the purpose of making arrangements for carrying on the work o the Institute during the ensuing year.

JOHN BLUE,
President General Mining Association of Quebec,

R. H. BROWN,
President Mining Society of Nova Scotia,

JAS. CONMEE,
President Ontario Mining Institute.

UNITED MEETING

—OF—

CANADIAN MINING ASSOCIATIONS

IN THE CHATEAU FRONTENAC, QUEBEC,

Thursday and Friday, June 27th and 28th, 1895.

Under the Auspices of the GENERAL MINING ASSOCIATION OF THE PROVINCE OF QUEBEC, there will be held a United Meeting of

The Mining Society of Nova Scotia, The Asbestos Club, The Ontario Mining Institute, and The General Mining Association of Quebec.

Meetings—Thursday Evening at 8 o'clock.

BUSINESS SESSION OF INDIVIDUAL SOCIETIES AT EIGHT O'CLOCK.

OPEN SESSION AT 8.30.
The Hon. E. J. Flynn, Commissioner of Crown Lands, in the Chair.

THE DEVELOPMENT OF OUR PHOSPHATE AND FERTILIZER INDUSTRIES. WHY THEY SHOULD BE ENCOURAGED.
(*a*) Phosphoric Acid in Agriculture.
By FRANK T. SHUTT, Chief Chemist, Dominion Experimental Farm, Ottawa.
(*b*) Canada—A Natural Manufacturing Centre for Fertilizers.
By MR. HENRY WIGGLESWORTH, New York.
(*c*) Phosphate's Future.
By CAPT. ROBT. C. ADAMS, Montreal.

RECENT IMPROVEMENTS IN, AND THE APPLICATION OF ELECTRICAL MACHINERY TO MINING (Illustrated).
By MR. W. F. DEAN, Montreal.

Excursions—Friday, June 28th.

On Friday morning, leaving the Chateau Frontenac at 10.30 a.m., there will be an excursion by Caleche to the principal points of interest in and around historic Quebec.

In the afternoon, at three o'clock, the members and their friends are invited by Messrs. Carrier, Lainé & Co., of Levis, to an excursion by special steamer, visiting the Chaudiere Falls, the Falls of Montmorenci, the Dry Dock, and the large engineering works of their firm.

Any business or papers left over from the meetings on Thursday will be finished at an evening session in Chateau Frontenac at eight o'clock.

Saturday Morning—Excursion to Lake St. John and the Saguenay.

It is proposed, provided a sufficient number of members and their friends are available, to have an excursion to Lake St. John and the far famed Saguenay, leaving via Quebec and Lake St. John Railway, St. Andrew Street Depot, on Saturday 29th June, at 8.30 a.m. There is first-class hotel accommodation at Roberval, delightful scenery and famous fishing. Sunday and Monday (Dominion Day) will be spent here, and on Tuesday the boat will be taken at Chicoutimi for the excursion down the Saguenay, arriving at Quebec the same evening.

Clubs.

By courtesy of the President and Members, members of the visiting associations have been extended the priviliges of the Union and Garrison Clubs during their stay in Quebec.

Hotels.

By special arrangement reduced rates for members have been secured as follows:

Chateau Frontenac - - - - -	$3 50
Florence House - - - - - -	2 00
Hotel Victoria - - - - - -	2 00

Transportation—Railways and Steamers.

INTERCOLONIAL RAILWAY OF CANADA—Members from Halifax and points on this line will, it is hoped, be carried to Levis and return for a single fare.

QUEBEC CENTRAL RAILWAY—Members from Sherbrooke and points on this line will be carried to Levis and return for a single fare on presentation of official Circular.

CANADIAN PACIFIC, GRAND TRUNK AND CANADA ATLANTIC RAILWAYS By special arrangement, members and their friends will be carried the round trip over these lines at a greatly reduced rate on obtaining Convention Certificate from Ticket Agent and on same being signed at Quebec by the Secretary. DO NOT FAIL TO ASK FOR IT AND ONLY BUY A SINGLE TICKET.

RICHELIEU AND ONTARIO NAVIGATION CO. (Boat service)—By special arrangements reduced fares as follows (exclusive of meals and berths):

	ONE WAY.	RETURN.
From Toronto to Quebec	$7 00	$13 00
From Kingston to Quebec	5 00	8 25
From Montreal to Quebec .. .	2 50	4 00
From Chicoutimi to Quebec	2 75	

A cordial invitation to be present is extended to all interested in the mineral development of the Dominion.

JOHN BLUE,
President.

B. T. A. BELL,
Secretary.

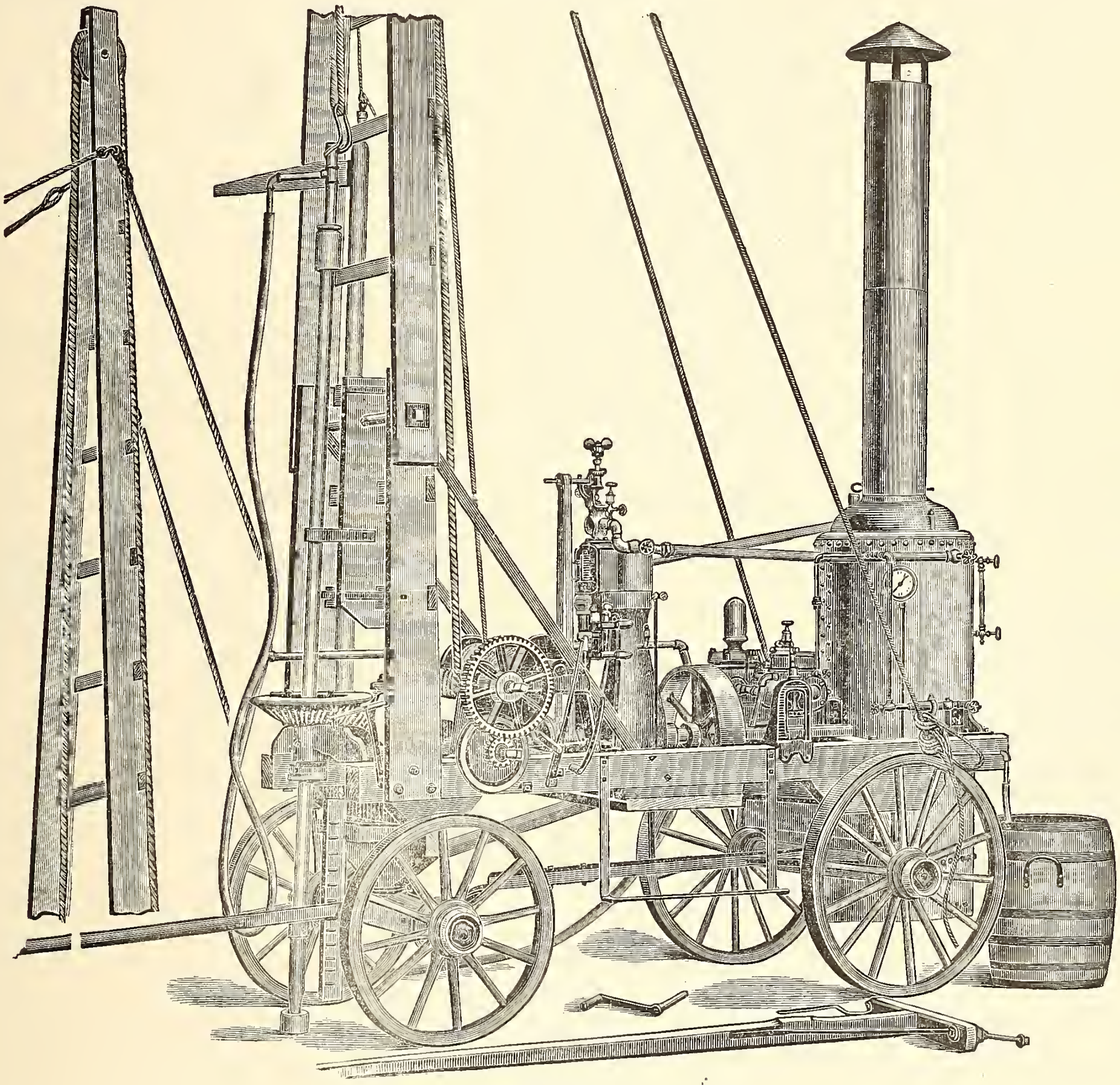
The Canadian Mining Review

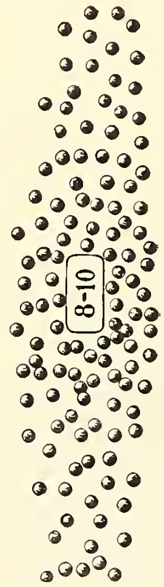
Established 1882

Vol. XIV.—No 6 | 1895—OTTAWA, JUNE—1895 | Vol. XIV.—No. 6.

Beal's Patent Core Drill

DOES THE WORK WITHOUT THE USE OF DIAMONDS.





SHOT

THIS DRILL does the work without the use of Diamonds, using as a substitute Chilled Steel Globules, or as they are commonly called, shot. These are inexpensive, costing in actual work about ten cents per day; whereas, diamonds are very expensive, a single one often costing from $80 to $100, thus showing the difference in cost in case of loss of tools. It is THE BEST, CHEAPEST, and MOST EFFECTIVE CORE DRILL made for Prospecting Quarries, Coal Lands, Sinking Wells and the like.

Owners of undeveloped Mineral and Quarry Lands can, with one of these machines, at a small outlay, bring them into a marketable condition. This Drill has been thoroughly tested in California Quartz Rock, Granite, Marble, Lime, Flint, Iron Ore, Sand Rock and everything in that formation, cutting the hardest as well as the softest material with great rapidity. It has also been very successfully used in Hard and Soft Coal, Shales, Slate, Clay, etc., taking out a core from 2in. to 6in. in diameter. It is an excellent machine for sinking air holes for Mines, Sounding Foundations for large Buildings, Bridges, etc

This Machine has been in practical use in the United States for several years, and was awarded the gold medal at the World's Columbian Exposition at Chicago, in 1893, in preference to all other core drills.

Length of machine, eleven feet; weight, mounted on truck as shown in cut, 5,000lbs. It can be easily loaded in a box car.

The Patentee, MOSES BEAL, ELYRIA, OHIO, U.S.A., would like to correspond with responsible parties with reference to the formation of a stock company for its manufacture in Canada, or would prefer to sell entire Canadian Patent.

The Patentee gives for reference any bank or business house in Elyria. Address him for full particulars. All letters will receive prompt attention.

For Full Information Apply to the
PATENTEE and SOLE MANUFACTURER,

MOSES BEAL, Elyria, Ohio, U.S.A.

MINING LAWS OF ONTARIO.

ANY person may explore Crown Lands for minerals.
Mining lands may be taken up as surveyed locations or staked claims.
Locations range from 40 to 320 acres.
Claims range from 10 to 20 acres on vein or lode.
Locations may be acquired in fee or under leasehold.
Price of locations north of French River, $2 to $3 per acre, and south of it, $2 to $1.50, according to distance from railway.
Rent of locations first year 60c. to $1 per acre, and subsequent years 15c. to 25c. per acre.
Rent of claims, $1 per acre each year.
Claims must be worked continuously.
Royalty on ores specified in the Act, 2 per cent. of value at pit's mouth less cost of labor and explosives.
Royalty not charged until seven years from date of patent or lease, nor (as provided in s. 4 (3) of the Mines' Act, 1892), until fifteen years in the case of an original discovery of ore or mineral.
Original discoverer of ore or mineral on claim entitled to stake out a second claim.
Crown Lands sold under provisions of mining laws in force prior to 4th May, 1891, exempt from royalty.
Copies of the Mines Act, 1892, Amendment Act, 1894, may be had on application to

ARCHIBALD BLUE,
Director Bureau of Mines

TORONTO, May 25th, 1894.

CONDITIONS
OF
Obtaining Government Drill to Explore Mines or Mineral Lands.

Owners or lessees of mines or mineral lands in Ontario may procure the use of a Government Diamond Drill, subject to the provisions of the Rules and Regulations relating thereto, upon giving a bond for payment to the Treasurer of the Province, of costs and charges for (1) freight to location, (2) working expenses of drill, including labor, fuel and water, (3) loss or breakage of bits, core lifters and core shells, (4) wear or loss of diamonds, (5) other repairs of breakages and wear and tear of machinery at a rate per month to be estimated, and (6) an additional charge of $50 per month after the mine or land has been shown, through use of the drill, to be a valuable mineral property.

Of the aggregate of costs and charges above enumerated, excepting the sixth item, forty per cent. will be borne by the Bureau of Mines in 1894, thirty-five per cent. in 1895, thirty per cent. in 1896, and twenty-five per cent. in each year thereafter until the end of 1900. All accounts payable monthly.

For Rules and Regulations *in extenso* governing the use by companies and mine owners of Diamond Drills, or other information referring to their employment, application may be made to ARCHIBALD BLUE, Director of the Bureau of Mines, Toronto.

A. S. HARDY,
Commissioner of Crown Lands.

Toronto, October 17, 1894.

The Canadian Mining Review
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B. T. A. BELL, Editor. Published Monthly. OFFICES: Sclater Building, Ottawa.

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The Kingston Blast Furnace and Steel Works.

The proposal to erect a furnace of 125 tons capacity, and steel works comprising furnace and rolling mill of 40 tons daily capacity, has been before the Kingston people and excited more than local interest. The advantages of the site and the vicinity of abundant iron ores of various qualities, have fostered an impression that Kingston, more than any other place in Eastern Ontario, is wonderfully well situated for such an enterprise. It is only the scepticism which ignorance engenders that entertains any doubt of the feasibility of obtaining charcoal supplies on the lines of the Kingston and Pembroke, Canadian Pacific, and Ottawa and Parry Sound railways, for a length of time beyond the average duration of the charcoal furnace. A project that would put in circulation for labor $6.50 for the fuel required for the manufacture of each ton of pig iron, should have some consideration from merchants and railway carriers.

Nevertheless, neither the scheme submitted by H. G. Hamilton and others has materialised, nor has any counter proposition been made by the Kingston people to invite the erection of a plant, which, as outlined by the Youngstown promoter, seem to be very suitable for the requirements of Ontario industry. The proposition submitted to the city plausibly offered in return for a grant of the site and a loan of $250,000, a mortgage of the works and of the Government bounty per ton of iron and steel until the loan should be fully repaid with interest. There seemed every probability that beyond the expense of the site the city would receive its entire outlay.

The negotiations do not appear to have been conducted with skill on either side. The Youngston proposal apparently involved the disposal of more or less of an existing plant. The examination of this part of the proposition should at once have been committed to a competent engineer. It is more than likely that there are many plants in the United States which would profitably bear removal to Canada. There are also others which are best suffered to remain on their sites as monuments of the folly of the mad speculation which founded them. It was not seemly on the part of the Kingston people to arrive at any premature conclusion as to the Youngstown proposition without at least the opinion of some one competent to pronounce upon the value of the plant proposed to be erected.

Before obtaining any evidence on this point the promoters were called upon to furnish evidence of the capital available for the enterprise. Here, the proposition received its quietus. There was plainly on the part of the city a demand that at least half a million of dollars should be in view before they would submit a by-law for the loan of about $300,000. It is doubtful if any proposition will ever be presented to any Canadian municipality where such a condition would be satisfied. A little care on the part of those engaged in promoting this enterprise might have led to the modification of the proposition for the loan and the city would thus have encouraged the erection of works, the want of which is a hindrance to the progress of the Province of Ontario.

The Youngstown proposal to Kingstonians was for a coke furnace. But we do not see why, having a meridianal railway worthless without traffic in forest products or minerals, the promoters were not invited to submit a proposal for a charcoal furnace. Probably it was thought the Youngstown gentlemen knew their own business. The Kingston people ought to keep in mind that in the townships in their rear there would soon be a different state of affairs if the charcoal burner were invited to ply his calling instead of that fire fiend, the free-grant settler. Charcoal at 5 cents a bushel makes the ordinary forest worth to the laborer one hundred dollars an acre, and to the railway carrier an average of twenty dollars an acre. Such figures ought to arouse the sleeping beauty, whose mausoleum is the Limestone City, from her slumbers. It is to be feared the effort will be in vain to arouse her. Fearing a renewal of Mr. Hamilton's proposition, one of the city papers came out with the request, all too pleasant in Kingstonian ears: "Give us a rest."

Aid to the Phosphate Industry.

One of the prominent features of the United Meeting of Canadian Mining Engineers, to be held at Quebec on 27th and 28th June, will be the consideration of a number of papers on the phosphate and fertiliser industries. The desirability of some direct assistance by the Governments—provincial and federal—to these industries is recognized by every one cognizant of our great phosphate resources in Quebec and Ontario, the depressed condition of that once flourishing industry and the possibility of its revival by the extension of the use of superphosphates by the Canadian farmer. Canada is a great wheat growing country, but as yet it uses only a few hundred tons of fertilizers per annum The cereals and grass crops extract from the soil (Annual Report of the Minister of Agriculture) 235 million pounds of phosphoric acid, equal to 117,972 short tons. Supposing one-half only to be returned to the soil in the stable manure, there is still a deficit of 50,000 tons of phosphoric acid. Taking 33 per cent. as a fair average of the phosphoric acid in Canadian apatite, the quantity of phosphoric acid to be restored to the soil would represent about 177,000 tons of apatite. The worn out cotton lands of Georgia, by the use of artificial manures were raised in twenty years from a value of $3 per acre to $30 per acre. The same transformation might take place in Quebec and the older provinces of the Dominion, could knowledge and enterprise be combined to apply the remedy. Every ton of phosphate that can be produced in Canada is needed in her own soil and should be sold for use here instead of being exported to Europe and often sacrificed in competition with inferior foreign phosphates or through losses by those tricks of trade that are so notable a feature of modern commerce. How shall this home market be extended? Primarily by the education of our farmers through the Departments of Agriculture, our experimental farms and our agricultural colleges of the value of superphosphates as a fertilizing agency. If the Governments will devote an appropriation to the spread of this knowledge and to the mining and manufacturing of phosphates, it would be of greater benefit to Canada than the same amount applied to any other industrial development, be what it may. In our next issue we will publish verbatim reports of the various papers and discussions on this subject to be presented at the June meeting of the Quebec and other mining associations.

EN PASSANT.

Notwithstanding rumors to the contrary, there is no material improvement in the phosphate market, Canadian being quoted in London at 8d. for 80%. The mines are still shut down.

A London correspondent writes:—"It is hard to get any one here to believe that any money is being made in mining in British Columbia. The present financial condition of the Provincial treasury militates immensely against private enterprise—especially as Mr. Turner is over here trying to raise another loan—which looks bad—and *Truth* has been running down the Provincial credit almost every week. A great deal may be said about business smartness here, but I fail to grasp what the financial condition of British Columbia has to do with the chances of success in gold mining. Investments here seem to be made on vague reports and mere generalities—such as 'Lots of money being made in the Transvaal; *ergo*, such and such a mining company is bound to be all right!'—and the ordinary public follow one or two men like a flock of sheep. A company for any part of West Australia or South Africa could be capitalized in one day. Everybody says the same thing."

The gold yield of the Province of British Columbia for the year 1894 is reported by the Hon. the Minister of Mines to have been $456,066, as compared with $379,535 in 1893 and $399,526 in 1892. Of this amount $380,055 was exported by the British Columbia banks, and $76,011 is estimated to have been carried away in private hands. The indications are that this season the output will be still further materially increased.

Perhaps no other manager is more widely known among the mining men of Canada than the subject of our portrait this month, Mr. George R. Smith, of the Bell's Asbestos Co., Ltd. Mr. Smith was, we believe, born in Newark, N.J., and had experience in slate quarrying and other professional work in the United States before coming to Canada in 1887 for the American Diamond Rock Boring Co., in charge of certain prospecting work with their diamond drills on the property of the Frontenac Lead Mining and Smelting Co., near Kingston, Ontario. In 1883 he visited Canada again, representing the Revenssler Falding Co., on a contract to open up the North Star phosphate mine on the Lievre River, Que. Here he remained only for some six months, being engaged by the Chapleau-Senecal syndicate to open up its phosphate properties on the opposite side of the river. On Senecal's death the company was dissolved, and Mr. Smith assumed the management for a number of years of the Little Rapids phosphate mine, where, in 1886, we have a lively recollection of his hospitality and a record run down the mine tramway. After severing his connection with the Little Rapids, Mr. Smith became associated with the Ingersoll Rock Drill Company of Canada, the Macgregor Lake Phosphate Company, and other enterprises, ultimately succeeding to his present position with the Bell's Asbestos Co. on the death of Captain Tom Sheridan in 1892. Mr. Smith is an officer of the Quebec Mining Association and the Asbestos Club, in whose affairs he has taken a prominent and active interest since their organization.

There is a rumour afloat to the effect that Col. Baker, Minister of Mines for British Columbia, has offered the appointment of Government Mining Engineer to Mr. W. A. Carlyle, Mining Engineer, for the past year or two Lecturer in Mining, at McGill College, Montreal. It is not known whether Mr. Carlyle has accepted the appointment. Mr. Carlyle is a capable engineer of some practical experience in silver-lead mining and milling in the Western States, and we heartily wish him every success in his new sphere of labor The appointment has been offered, we undeistand, very largely on the recommendation of Dr. George Dawson, C.M.G., Director of the Geological Survey.

The *Finanical News*, London, advises the British public to look to West Kootenay, and to invest there instead of in South America and elsewhere in foreign lands, where investments so made have to be shadowed by one of H. M. gunboats. This shows that British Columbia has only to be heard of to be appreciated, and the best policy for all British Columbians to adopt is to see what means would the sooner bring about the object. It is to be hoped that the Government will join with those who are striving to make known abroad the mineral resources of the Province in the same way that the governments of other colonies have done, and there can be no question that the results that will accrue will yield an ample return for the little expenditure requisite for the purpose.

A western contemporary pithily remarks: The absolute indifference of Canadians generally and eastern Canadians in particular to the mining developments of their own great country is enough to make a citizen of West Kootenay weary and tired. If the capital in Montreal, Toronto, Ottawa and other eastern cities that is used annually for gambling on Wall Street, New York, or on the wheat exchange, Chicago, Ill., or on the mining exchange, Denver, Col., were put into development work throughout the great mineral zone in British Columbia, which is as great or greater than any mineral bearing area in the United States, not only would we see more rapid development of the conntry, but we would see immense fortunes made by our own countrymen. We would also see some point in the east become one of the world's great trading centers for the refined product of Canadian mines. Canada would become a great exporter of the precious metals and Canadian commerce in every branch would feel the stimulus. But no, our precious metals now being mined in bulk, must filter through the markets of the United States into the commerce of the world, bringing prosperity it is true, to the loyal Canadians of West Kootenay, but in their ultimate and most far-reaching effects, doing no more for Canada than if the 49th parallel lay north instead of south of West Kootenay. Trail Creek is now producing $4,000 a day in solid gold. During 1895 it will export $2,000,000 worth of the precious metal, or 5 per cent. of the whole output of the United States. Who in Canada knows or cares anything about so comparatively uninteresting a fact, and what enterprising Canadian capitalist is reaching out a hand for a share in the golden shower? Trail Creek is now greater than Cariboo in its palmiest days and more permanent, but British Columbian ears are so stuffed with the traditions of Cariboo that the noise of a present day movement disturbs them no more than it would the lotus eaters of Alfred Tennyson."

CORRESPONDENCE.

The Geological Survey.

SIR,—To investigate and report upon the mineral resources of the Dominion is a statutory duty of the Geological Survey. That this work should be of like practical value with reports supplied by the Geological Surveys of the States of the American Union is not a disputable proposition. There is no reason assignable for conducting this portion of the business of the survey on any other line than according to the best standards. What have we to show for the hundreds of thousands of dollars our Geological Survey has cost us that can for one moment compare with the report of the Winchells on the Iron Ores of Minnesota,—a work which has had no small influence in promoting the development of the great iron mines of that State? It is not because the gentlemen connected with the Canadian Survey are less scholarly or professionally unqualified that the work of the Survey for the development of our mineral interests cannot for a moment vie with the work of American geologists, but because an unwise policy has guided their aims. May we hope that in future the Survey shall rest upon its laurels in the departments of Archæology, Indian linguistics and Palæontology, and devote attention to particular districts of definite mineral resources, the opening up of which will contribute to the prosperity of the country as well as to the reputation of the Survey for scientific investigations of practical value.

Yours, &c., KINGSTONIAN.

KINGSTON, 18th June, '95.

Mr. GEORGE R. SMITH, *Superintendent,*

Bell's Asbestos Co. Ltd., Thetford Mines, Que.

PERSONAL NOTES.

Mr. E. D. Ingall, M.E., A.R.S.M., chief of the Division of Mines and Mineral Statistics, is on leave of absence. A brief rest and change of air, it is hoped, will prove beneficial to his health, which, for some time past has been far from good.

Mr. Robert Archibald, C. & M. E., has severed his connection as mine superintendent of the Canada Coals and Railway Co., and is now in Scotland.

Mr. Harry Williams, for a number of years mine superintendent with the Beaver Asbestos Co., Ltd., has been appointed to a position with the Danville Slate and Asbestos Co., Ltd.

Mr. R. G. Leckie, M.E., late general manager of the Londonderry Iron Co., has gone to Fredericton, N.B., to operate his coal and iron properties at Grand Lake, N.B.

Capt. Robert C. Adams, Montreal, has gone to Midway, B.C., for the summer, to look after his various mineral interests in the Boundary Creek district.

Mr. H. P. H. Brummell, of the Geological Survey of Canada, having been appointed manager of the North American Graphite Co. Ltd., has left the Survey. The Dixon property in the Township of Buckingham, Que., is to be operated.

Mr. W. F. Sergeant, Tacoma, Wash., secretary of the Slough Creek Mining Co., has been in Montreal lately interesting capital in the Cariboo District, B.C.

Mr. J. Obalski, Inspector of Mines for Quebec, passed through Ottawa on 12th inst. on his annual inspection of the Ottawa County mines.

Mr. C. A. Meissner, an experienced operator from New Birmingham, Ala., has been appointed manager to the Londonderry Iron Co., in succession to Mr. R. G. Leckie.

CANADIAN COMPANIES

Dominion Coal Company, Ltd.

The report of the Directors and accounts for the fourteen months ended 28th February last, submitted at the annual meeting on 6th June, are as follows:—In submitting this report the attention of shareholders is called to the fact that to the time of making the report for 1893 the operations of this company were carried on for about ten months, but in consequence of the change in the fiscal year, which now begins March 1st, this present report covers a period of fourteen months.

January and February are months when the mines are practically closed and no revenue is received. The accounts for these two months are shown separately. Had this statement included but twelve months from January 1, 1894, the net surplus would stand increased by the sum of $64,597.65, or $92,211.56 instead of $27,613.91.

The quantity of coal mined was 1,020,537 tons, being an increase of 186,518 tons over the business of 1893.

In addition to this business much progress has been made in opening new pits, one on a seam of coal believed to be of superior quality, and in providing modern apparatus and machinery for mining and handling coal. This work is so far complete that no further expenditures are contemplated. As the coal seams of Cape Breton resemble those of the United States, it is believed that the same cheapening of cost will follow these improvements in the one case as in the other.

This cheaper cost of production and cheaper transportation will enable the company to market its coal in places which would otherwise be inaccessible, thus making a larger output possible, increasing the length of time when mining operations can be carried on, increasing the revenue of the Company and giving more employment and for a longer time to its employees.

The railroad to Louisburg is substantially completed as well as its piers at Sydney and Louisburg, and it is expected that the railroad will be open for freight and passenger business over the whole route on the first of July. The opening of the road to Louisburg will afford for the first time an opportunity for winter shipments of coal, and will consequently cheapen the cost of sea transportation to the lower Maritime Provinces, and to New England ports. The road is now forty-two miles in length, with grades exceedingly favorable. It is laid with 80-lb. rails and is in every respect first-class, and has connection by branches to all the company's collieries but one. That one is located at some distance from the main line and is equipped with a short piece of railroad and independent pier. During the past year a large amount of equipment, principally coal cars (of which four hundred are of a capacity of sixteen tons each) and three locomotives have been added. The local freight and passenger traffic has proved satisfactory.

All the construction work in contemplation at the time of organization is now completed. All of the bonds held for this expenditure ($1,500,000) have been sold at a satisfactory price. The proceeds (in part received) place the company in a satisfactory financial position.

The net revenue since organization has been sufficient to provide for all interest, sinking fund and dividend requirements on preferred stock and to pay a considerable sum toward depreciation and expenses for change in the fiscal year. When the savings by the new methods begin to be realized, it is believed that the net results will show a gratifying increase which can be used for dividends on the common stock.

The sinking fund provision for the bonds requires the payment to the trustees, the New England Trust Company, of two cents per ton on all coal mined the first year (1893), three cents the second year, four cents the third year, and five cents thereafter, and after the sum of $125,000 has been received by the trustees (which shall be held in cash or in securities) the bonds will be called for payment and cancellation. Even on the present basis of output a small amount will be required to be called in April, 1897, and thereafter an amount equal to five cents per ton on the output. The amount now in the sinking fund has been invested in United States bonds.

Report of the Treasurer, January 1, 1894, to February 28, 1895.

Net proceeds $1,020,537 tons coal, less cost mining, transportation, royalty, etc		$184,075 01
Profit on Steamships, railway, barges, etc		196,873 43
		$380,948 44
From which has been paid—		
Balance sinking fund (1893)	$320 43	
Interest	176,864 31	
Dividends, preferred stock	120,000 00	
General expense	47,857 69	
		345,042 43
Balance		$35,906 01
Add—		
Surplus from 1893	$51,977 48	
4 months' interest allowed in 1893 statement afterwards paid in above interest account	30,000 00	
		81,977 48
Total		$117,883 49
For which provision must be made for—		
Dividend preferred Stock, 2 months, January and February, 1895	$20,000 00	
Sundry accounts payable	3,343 45	
Sinking fund	28,055 05	
		51,398 50
		$66,484 99
Add subsidy received for railway construction		64,000 00
Gross surplus		$130,484 99
Written off as follows—		
Subsidy to suspense account for future depreciation railway and equipment	$64,000 00	
To profit and loss, depreciation in property	21,054 98	
" " provision doubtful accounts	5,638 42	
" " sundry items properly chargeable to 1893 business	12,177 68	
		102,871 08
Net surplus carried over		$27,613 91
NOTE—This surplus remains after deducting expenses of two unproductive months, costing as follows:—		
Maintenance of mines, offices, etc	$29,597 65	
Interest on bonds	15,000 00	
Dividend, preferred stock	20,000 00	
Total	$64,597 65	

Balances, February 28, 1895.

Assets—		
Property	$19,194,123 54	
New supplies warehouses and stores	107,315 09	
Agents' balances	188,085 10	
Bills receivable	3,000 00	
New England Trust Co. sinking fund	15,469 28	
" " interest account	63,465 00	
" " special account	106 00	
American Loan & Trust Co., dividend account	1,892 00	
Cash	54,041 76	
		$19,627,497 77
Liabilities—		
Common stock	$15,000,000 00	
Preferred stock	1,500,000 00	
First mortgage bonds	2,100,000 00	
Bills payable	719,147 64	
Unpaid coupons	63,465 00	
" dividends	1,892 00	
Coal, balance payable	29,026 91	
Accounts payable	3,343 45	
Royalty, 5 months	32,082 73	
Accrued dividend, 2 months	20,000 00	
Sinking fund	28,055 05	
Railway subsidy, suspense account	64,000 00	
To profit and loss	38,871 08	
" surplus 1895	27,613 91	
		$19,627,497 77

Boston, June 6, 1895.

J. S. McLennan,
Treasurer.

New Vancouver Coal Mining and Land Co., Ltd.—At the meeting of shareholders held in London, Eng., last month, a balance dividend of 2 per cent. was declared, making 4 per cent. for the year 1894, carrying forward nearly £18,000 to credit of profit and loss. The net output in the half year ended December 31st was 169,183 tons, making a total for the year of 345,283 tons, while the sales in the half-year were 171,973 tons, making the total for the year 347,573 tons.

Paris Belle Gold Mining Co., Ltd., has been incorporated under the B. C. (foreign) Companies Act, with an authorized capital of $800, and headquarters at Spokane, Wash., to carry on mining operations in the Province of British Columbia.

Good Hope Mining and Milling Co., Ltd., has been incorporated in Spokane, Wash., with an authorized capital of $500,000, in shares of $100, to carry on mining in the Province of British Columbia. The incorporators are Frank Guse, Spokane, Wash., President; E. L. Hooper, G. Mackie, Peter Steep, Wm. Townsend and James Maxwell.

The Granite Creek Mining Co., Ltd.—This company has applied for incorporation under the Dominion Statutes. The objects are to purchase, take over or otherwise acquire, in whole or in part, the mineral lands, mines, estate, both real and personal, properties, rights, credits, privileges, business, good-will, and assets of the Stevenson Gold and Platinum Hydraulic Mining Co. (Limited Liability), and to assume, undertake and pay all liens, charges and incumbrances affecting the same or any one or more of them, or any part thereof respectively, and also to assume, undertake and pay all the liabilities of the said The Stevenson Gold and Platinum Mining Co. (Limited Liability) and to purchase and sell gold, silver, copper, nickel, iron and other metals in the Dominion of Canada and elsewhere. Directors: Robert Stevenson, Chilliwack; Wm. Lovitt Hogg, Inspector of the Western Loan and Trust Co., Ltd.; W. Barclay Stephens, Manager of the Western Loan and Trust Co., Ltd.; Clarence Gillard, physician, and James Naismith Greenshields, advocate, all of the city of Montreal, in the Province of Quebec, and Andrew Walker Fleck, Esq., and Wm. Dale Harris, civil engineer, both of the city of Ottawa, in the Province of Ontario. Authorized capital stock, $150,000, in 15,000 shares of a value of $10.00 each.

Nanaimo Rossland Mining Co., Ltd.—Gives notice of application for charter under B. C. statutes. Authorized capital, $500,000. Directors: C. U. Westwood, Nanaimo, B.C.; Jas. McGregor, A. Jenkins, W. K. Leighton, and Thos. Kitchin, all of Nanaimo. Head office: Nanaimo, B.C.

Mineral Creek Gold Mining Co., Ltd., has been formed in British Columbia to acquire mineral claims on Vancouver Island, and particularly "The Alberni," "The Warspite," "The Victoria," "The Halifax," and "The American Boy," as well as placer claims known as "The Spike Horn," "Mint," "Hidden Bank," "Enterprise," "Golden Star," and "Black Hawk," all of which are situated on mineral Creek, in Alberni district, B.C. Authorized capital, $500,000. Head office: Nanaimo, B.C. Directors: George Bevilockway, W. J. Curry, and Percy Lorne Simpson, of Nanaimo, and Walter Jones, of Wellington, B.C.

Horsefly Hydraulic Mining Co., Ltd.—Advices received up to the 25th of May state that there is abundance of water. The result of the big blast (which was mentioned in our last issue) has been most satisfactory, the gravel being thoroughly shaken up and the amount of gravel operated on effectively is much greater in consequence. The first clean-up for this season is expected to be made between the beginning and middle of July next.

Cariboo Hydraulic Mining Co., Ltd.—Reports from Quesnelle Forks, up to May 24th, state that the company was running 8 hours a day with about 2,000 miner's inches of water. Since then heavy rain has fallen, and there is now an abundant supply of water, so that work can be carried on without intermission on the three-shift plan. Before the supply of water from the present available sources is exhausted, the ditch will be completed from Hazleton Creek to Polley's Lake, when there will be at all times an ample supply of water. The company has now 400 men at work on the construction of the ditch, which is to be completed by the end of July. These extensive undertakings have infused new life into the district and the success of these hydraulic companies will have results—direct and indirect—on the future of Cariboo which can scarcely be overrated. The first clean-up will probably not be made till sometime in July.

West Le Roi and Josie Mining Co., with a capital stock of $500,000. The incorporators are George H. Casey, of Butte, Chas. G. Griffith, of Helena, John M. Burke, D. Holzman, Sam Silverman, John L. Wilson, J. B. Jones, C. S. Vorhees, and H. M. Stephens, all of Spokane, and Ross Thompson, of Rossland. The principal offices are to be in Spokane. The company is to erect all kinds of mining machinery, deal in real estate, etc.

The Robert E. Lee Mining Co. have incorporated for a period of 50 years, and will buy, sell, hold, lease and operate mines in the United States and British Columbia. The principal place of business will be in Spokane. The capital stock is $500,000, divided into 500,000 shares of $1 each. John M. Burke, W. Clayton Miller, J. L. Wilson, C. S. Vorhees, C. W. Ide, and A. P. Sawyer are directors.

The Eureka Concentrating and Mining Co. is another concern that has been incorporated for a period of 50 years, and will buy, sell, hold, lease and operate mines in the United States and British Columbia. Headquarters will be at Spokane. The capital stock is $500,000, divided into 500,000 shares at $1 each. John M. Burke, J. B. Jones, Ross Thompson, S. Rosenhaupt, H. L. Wilson, O. D. Garrison, and G. W. Dickenson will act as the board of directors.

Mountain Sprite Mining Co. of Tacoma.—Capital stock, $500,000, in 500,000 shares of $1 each. Incorporators, Nelson Bennett, M. V. B. Stacy, and Henry Blackwood; to operate mines and handle mining machinery in Washington and British Columbia.

The Lookout Mining and Milling Co., with headquarters at Spokane, has been incorporated with a capital of $250,000. G. E. Kumpe, E. W. Talbot, L. R. Lindsey and Geo. E. Pfunder are the trustees.

Consolidated Gold Lake Mining Co., Ltd.—Capital, $400,000. J. B. Neily, President; W. A. Temple, vice-president, and James Reeves, secretary-treasurer, with H. C. Walker and G. H. Mackinley as directors. The property consists of 305 areas at Gold Lake, N.S., and 400 acres of land.

The St. Elmo Mining Co. has been incorporated by Spokane parties to operate the St. Elmo claim on Red Mountain. The incorporators are Frank C. Loring, George W. Crane, F. E. Snodgrass, E. D. Olmstead, and R. E. Coe. The office of the company will be at Spokane. The St. Elmo is the highest claim on Red Mountain and was originally located by Samuel Creston. It lies between the Mountain View on the one side, which is being operated by W. H. Taylor, and the St. Elmo Consolidated on the other, on which J. R. Cook and J. B. McArthur have an option. At various times during the past four years Sam Creston has sold small interests to L. Mulholland; and on the 10th of May the whole claim was sold at a large figure to F. C. Loring and G. W. Crane of the Josie mine on thirty and sixty days' time.

Alexandra Mining and Dredging Co., Ltd., has been incorporated under British Columbia statutes, with an authorized capital of $3,000,000, to carry on mining in that province. Head office: Vancouver, B.C. Directors: Marshall H. Alworth, Charles Wilson, John B. Heinrick, George Turner, and J. B. Hanrahan.

MINING NOTES

Nova Scotia.

Caribou District.—Some little excitement has been caused by the finding of some rich quartz about two miles from this district on ground prospected some years ago by Mr. Touquoy. It is yet too soon to predict that this discovery means a new district, as the pocket found appears to be in a cross vein and not on a regular lode.

The Sanders (formerly "Lake Lode") property is reported to have uncovered some high grade quartz, and the property owned by Jack & Bell of Halifax is also in good ore.

Reports from the Caribou Gold Mining Co. area are not encouraging. The yield from the old Dixon mine is said to be decreasing, and the efforts of the company to open up high grade rock have not as yet been successful. Rumor has it that an effort will be made to place the property in either the New York or London market.

Moose River District.—Mr. Damas Touquoy continues to crush the surface gravel from some of his areas with success. He is enabled to make a small profit on this material at 60c. per ton. The output from his quartz mine is being increased and maintains its average yield.

Mr. MacGregor has resumed work on the large body of low grade rock in the Moose River Gold Mining Co's property. Recent crushings have been made at a profit, and the summer will see a considerable increase in the output.

Fifteen Mile Stream.—Some changes in the plant here were made during the spring and returns for April and May show large yields. This district is much hampered by its bad roads, but has abundance of good ground awaiting exploitation.

Oldham.—Nothing is doing here beyond tribute work.

Renfrew.—The Pictou Development Co. have not yet completed the sale of their property to New York parties—rumor says the deal is off. The McLeod lode continues to show rich quartz in pockets, and the Ophir lode is to be re-opened and tested. Returns from the district are good.

Montagu.—The recent decision affecting the validity of the Temple-Logan title to the old British-American areas is causing great comment and no little uneasiness in gold-mining circles. The burdens capital has to bear in opening up our mineral fields are heavy enough without the addition of an uncertain title. The difficulty appears to have arisen through loose and ambiguous wording of the statute, and is a commentary on the present loose system of amending the mining laws. The decision of the courts will undoubtedly occasion a change in the statute, but this process of reforming the language of the Provincial Acts will be found decidedly detrimental to the introduction of capital to develop the province's resources.

Waverley.—The Tudor Gold Mining Co., Ltd., continues to be the only producing concern in this district. Its Dominion Shaft now has a depth of about 500 ft. The cuts made by the railway in crossing the measures of this district have so far failed to discover any new veins or facts of value.

Cochran Hill.—The Supreme Court, in rendering a decision against the Cochran Hill Mining Co. in a suit for debt recently tried, took occasion to comment most forcibly and appropriately on the financial methods and ideas of the promoters and directors of this company, to all of which the REVIEW says *Amen*. The responsibility the English law imposes on directors of limited liability companies should obtain throughout Canada, and the sooner the better.

Some Boston and New York gentlemen some time ago acquired some passibly good coal areas in Inverness County, Cape Breton, and organized a company under the laws of Maine for the purpose of opening up and developing the same. Recently the same parties also acquired valuable rights on a block of fine coal property on the Pictou coal fields, and also a broad and liberal charter passed by the N. S. Government in 1894, with a view of consolidating the two interests. H. A. Ely and A. C. Jones, of Boston, recently visited Pictou and examined into the merits of the new coal area, and returned to Boston very much pleased with the prospects. They purpose putting the matter before capitalists who are willing to furnish the capital necessary to open and work the properties provided they are satisfied the statements made to them are correct. It was for this purpose Mr. Ely visited the ground personally and saw for himself. The negotiations for the acquirement of the Pictou areas and the N. S. charter were conducted through E. A. Charters, of Sussex, who is also the secretary of the Inverness Coal Mining Company. They possess a good property and there is no doubt the necessary capital to operate it on a large scale will be forthcoming. First-class chances of shipment, both by rail and water, exist on and near the property.

New Brunswick.

The mining news from this Province is not of a very positive nature, but it looks as if a boom was in store and a possibility of some developments being made that may be of importance.

The Local Government of New Brunswick has made arrangements to conduct a series of borings at Salt Springs, in Kings Co., near Upham. Salt brine from flowing springs was utilized some years ago in manufacture of salt, but the brine being low in percentage, cost of manufacture would not permit of its coming into competition with Upper Province and American Salt. The object now is to ascertain if, by boring, a stronger brine cannot be had and perhaps the salt rock itself. The salt made at this point formerly and at Hendricks Spring, a short distance above Sussex, is the finest on this side of the Atlantic for dairying purposes, and as a table salt also. A chance for investment of capital at the last point named can be had, and with improved plant there is no doubt a good return on a fairly moderate investment could be made.

The development of Grand Lake coal bids fair to be among the possibilities. R. G. Leckie and some American capitalists, it is said, will expend some money there to determine the value of same. Provided the smelting furnace is erected in St. John by Mr. Leckie and his associates, it is possible Grand Lake coal will furnish the fuel necessities. Should a cheap and expeditious system of mining the coal be devised, as a furnace fuel for factories, etc., it may be in good demand, but at present its coming into competition with Cape Breton or Nova Scotia coal for house use is doubtful.

Some New York people recently visited Albert County to examine the prospects of a deposit of Albertite coal, which outcrops there in fairly good quantity, and may prove to be of very much value. It would be a boon to Albert County to have this once important and highly remunerative industry again revived. The visitors who have control of the property in question it is said are very favorably impressed and will expend some money in development at an early day.

The promoters of the Baltimore Coal Mining Co., which is duly incorporated under the laws of the Province of New Brunswick, with a capital of $300,000, are engaged quietly in perfecting their operations for a development or sale of the same. Mr. John Harding, of St. John, a veteran organizer of companies, is interested in the project, and recently explained his views on the possibilities of this shale to parties in Montreal, according to the *Star*. The location of this property is in Albert County, and but a short distance from good shipment.

The sale of a gypsum property at or near Petitcodiac is reported, to New York parties, by gentlemen in Moncton, who have had control of the same. Just what may be done is not yet apparent. It is said the deposit is very large and near good railway facilities.

Some time ago a company was announced having a view to the prospecting and boring for coal at Dunnmore, about eight or ten miles above Sussex. Coal in small quantities and of a very good character has been taken from a vein near surface, and it is believed that boring would prove the existence of other and underlying seams of working value. As no move has yet been made it is not known what the intentions of the promoters are. Kilgar Sheves, Esq., of Campbellton, N.B., on whose property the coal lies, is principal promoter of the scheme.

Last fall exciting rumours of the discovery of visible gold in quartz were in vogue and said to be gotten from a vein in one of the branches of the Upsalgulch River, in the County of Restigouche. Fine quartz, well studded with gold, was freely exhibited, but as no move has been made to prove or develop it, the knowing ones smile and think a piece of Nova Scotia gold quartz drifted over here by accident, and the gold mining boom in Campbellton is quiet now.

I have heard of the probable discovery of asbestos in a certain locality in New Brunswick. Search has been persistently made for some time for same. What the actual facts are I cannot say, but if it proves to be authentic, I shall give you correct particulars at a later day.

Mineral springs are abundant in Nova Scotia and New Brunswick. The writer has assays of four or five, and any person interested in such matters can obtain information by inquiry at office of REVIEW where address will be furnished. In the meantime I shall try and be more regular in future in mining notes for your valuable journal.

A mining party belonging to Woodstock, N.B., have gone on to the Tobique to a point called Gold Brook, in search for gold. This syndicate have been prospecting in this locality for some time and at various times found first-class indications of gold. A small stamp-mill has been bought and is being taken in for practical tests. The gold is said to be in low grade ores and any quantity of material. Just what the yield is per ton is not known. It is to be hoped the attempt will meet with success, as should the existence of gold in paying quantities be proved it will very materially add to the chances for investment of capital in this province.

Quebec.

A good deal of activity is noticeable at the asbestos mines, and although prices are not what they ought to be, the output should be quite up to that of last year. The following companies are operating. Bell's Asbestos Co. Ltd., Johnson's Co. Ltd., King Bros., Danville Slate and Asbestos Co. Ltd., Anglo-Canadian Co. Ltd., American and United companies.

The Eustis and Nichols pyrites mines at Capelton, are reported to be working night and day shifts and producing large quantities of ore.

In the Ottawa County district Wallingford Bros., Lake Girard and Vavasour Mining Association are producing mica, and the Walker Mining Company's mill is running on plumbago. Only a small quantity of phosphate has gone forward.

British Columbia.

Vancouver Island.

The output of coal for the twelve months ended 31st December last was :—

	Tons.
New Vancouver Coal Mining and Land Co	304,624
R. Dunsmuir & Sons	376,956
Union Colliery Co	241,372
Total output, 1894	1,012,953
Add balance on hand 1st Jan., 1894	19,044
Total coal for disposal, 1894	1,031,997

The exports during the year amounted to 827,642 tons as follows :—

	Tons.
New Vancouver Coal Co	280,130
R. Dunsmuir & Sons	304,852
Union Colliery	233,660
Total exports	827,642
Home consumption	165,776
On hand 1st Jan., 1895	38,579
Total	1,031,998

Cariboo District.

During last season upwards of sixty applications, aside from those held by the ordinary record, were made to the Gold Commissioner for ground for hydraulic mining in various parts of this district, upon some of which very large expenditures are being made.

The output of gold for 1894 is estimated to have been :—

Barkerville Division	$66,300
Lightning Creek	34,700
Quesnelle Mouth	26,200
Keithley Creek and Quesnelle Forks	65,150
Estimated product 15th Nov. to 31st Dec	10,000
	$202,350

The first clear-up for the season of the Horsefly and Cariboo Company's claims was to have been made on 15th, and much interest is manifested in the returns, which are expected to be rich, both in British Columbia and in Toronto and Montreal, where a large portion of their stock is held.

On the lower part of Quesnelle River the Quesnelle River Hydraulic Mining Co. obtained a lease of ground last season and brought in pipes and monitor during the winter, constructed ditches and dams, and got pipes laid, but not in time to take advantage of the water supply. However, they managed to secure a few hours run, which gave satisfactory returns.

Cassear District.

The following has been estimated by the Gold Commissioner to be the yield of gold from this district in 1894 :—

Dease Creek	$8,300
Thibert Creek	4,000
McDame Creek	9,550
Rosella Creek	200
Grand River Division	350
Stickeen River Division	300
	22,700

East Kootenay.

The yield of gold from the various creeks in 1894, is estimated as follows :—

Wild Horse Creek	$22,500
Perry Creek	300
Moyie River	1,800
Desultory mining, say	300
	$24,900

showing an increase of $5,200 over 1893.

On Wild Horse Creek the hydraulic operations of the East Kootenay Exploration Syndicate have given very fair results, considering many unforeseen drawbacks which occurred to impede. Operations were commenced under the superintendence of Mr. Beatson, a Californian mining superintendent, early in May. Great delay took place, owing to land slides, which carried away large portions of the Victoria ditch. During the extremely high water of the past season the old dam at the head of the ditch was carried out, occasioning, altogether, delay of over six weeks at the most important part of the season. The pipe plant purchased some years back seems to have given much trouble, not proving sufficiently strong for the pressure of the head of water of 370 ft. The head had to be diminished to the extent of about 130 feet by introducing a pressure-box at a lower level, thus decreasing the efficiency of the giants. In August a new giant was received from Messrs. Hendry, of San Francisco, and piping was commenced towards the end of the month and continued to the end of October. The quantity of gravel put through the sluices for the season was 77,500 cubic yards, or 0.66 of a cubic yard of gravel for each 10 hours miner's inch of water used. It is estimated that this efficiency could be increased to 1 cubic yard per 10 hours miner's inch of water by the introduction of a proper pipe plant, using the full head of water; or by using electric light and working 24 hours, the quantity could be increased to 2½ cubic yards of gravel for each miner's inch of water. The operations showed that the company's ground on Wild Horse Creek can be worked at a handsome profit.

The Ridgway Company has, for a long time, been prospecting for placer on different portions of the Moyie River. During last summer they discovered some good pay ground in an old channel and have obtained a lease covering the ground desired. The work which they have done consists of a drift of about 80 feet long, run into the bank at an elevation of 5 feet above the river, at the end of which an incline was sunk to bed-rock, where some very good prospects were found, viz., $85 to the last two sets of timber. As water gave trouble, a drain was run, about 600 feet in length, from a point further down the river to reach the foot of the incline. The ground reached here proved not nearly as rich as indicated by the first prospects found. After drifting 300 feet further, however, another pay streak was found, stated to be about 40 feet wide and 5 feet high. A drift was run some distance in this, and breasted out some distance on each side. This ground was paying well when a serious accident occurred. The timbering at the face of the drift gave way, and nine sets in succession from the face fell in, one of the miners, John Ridgway, being buried; another man, working near him, succeeded in extricating himself. A rescuing party commenced work at once, additional men being sent out by the Mining Recorder at Fort Steele. Two shifts were worked continuously. After eight days' work, night and day, the front of the drift was reached. Ridgway's body was found, dreadfully crushed; death must have been instantaneous. The cause of the accident is attributed to the neglect to brace the sets longitudinally to one another. When the first set tipped back, the weight on the sagging brought each set down in succession in a similar way.

Lillooet District.

The total yield of gold (ascertained from reliable sources only) was, in 1894, $39,257, showing a decrease as compared with 1893, of $12,119, and very much below the average of the past ten years. The extreme high water in all auriferous streams in this district, in the early summer, put a full stop to mining for nearly two months, and this cause must largely account for the shrinkage in production.

Yale District.

The Thompson River Hydraulic Mining Co., at Tranquille, had the misfortune to lose their dam, which was carried away by the great pressure of water to which it was subjected. The structure was forty feet high, and the work required to build another so delayed operations that but two or three days' piping with an inadequate supply of water could be obtained. The results, however, proved very satisfactory, the gravel in the pay streak returning at the rate of fifty cents to the cubic yard. This company has expended a large amount of money and is fully deserving of success.

The Glen Iron Mining Co. at Cherry Creek, has shipped one thousand tons of ore to the Tacoma smelter, and have a contract for supplying one thousand tons more at a higher figure than that previously obtained. Ten men are at work, and the probability is that a much larger number will be employed next summer, as the excellent quality of the ore, which is comparatively free from impurities, is largely increasing its demand.

Mr. D. Gilman, of Seattle, who is the president of the Lake Shore and Eastern railway, has bonded the mine in the sum of $60,000 for a period of six months. Should the deal be effected the production will be greatly increased to supply the wants of extensive iron works which are to be erected at Seattle for the manufacture of railway cars.

The Adams Lake group of mines promises to become very valuable. The principal work has been accomplished in the Homestake and Troublesome mineral claims, owned by Messrs. Olsen and Flynn, who will shortly reap the benefit arising from their energy and perseverance. An average lot of twenty tons of ore shipped to the smelter at Everett, Wash., U.S., yielded $1,200. There are two distinct lodes running parallel to each other through these locations. The first has been cross-cut and found to be twenty feet thick. The tunnel is being carried forward to intersect the second vein, which has about two feet of very rich ore on the hanging wall averaging from 500 to 3,000 ounces per ton in silver. This portion of the ledge is broken up and difficult to trace on the surface, but it is expected will be found intact when depth is attained.

Osoyoos Division.

Foremost amongst the mineral claims in the district at the present time are the Cariboo and Amelia, owned by the Cariboo Mining and Milling Co., of Spokane, Wash. Early in the present year the company brought in a ten stamp mill to work their ore, and since the 1st day of May (when it started running) up to the 1st instant it had worked 163 days, milled 3,100 tons of ore, which produced gold to the value of $34,750 and about 60 tons of concentrates. The work, principally on the Cariboo, consists of 675 feet of tunneling, at a depth of from 60 to 80 feet, 370 feet of which was run this year. The area stoped out will amount to about 170 feet long, 50 feet deep, and 4 feet wide. About 30 men have been constantly employed in the mine and about the mill during the summer, and I believe it is the intention of the company to keep the mill running all winter, if not prevented by frost.

On the Eureka, owned by Mr. John Douglas, there is a shaft 159 feet deep, and a drift at the 80 foot lead of 112 feet. No work has been done on this claim this season.

On the Fontenoy, belonging to Mr. Hugh Cameron, an 83 foot shaft has been sunk, and the rock, which carries silver, lead and gold, has assayed as high as $400 per ton. The average is about $24 in silver and gold.

On the Alice and Emma there is a shaft 62 feet deep, the ore from which is a free-milling sulphuret.

The Maple Leaf, owned by James Lynch, adjoins the Alice and Emma. On this claim a shaft has been sunk 30 feet, and at that depth free gold is found.

Three miles from the camp is the Snowdon, situated near the falls of Rock Creek; owners, Messrs. Elliott and James, who claim $50 per ton for the rock.

The Victoria, owned by the Haynes Estate, Basche & Goericke, has an incline shaft 110 feet in depth. From this claim some very rich ore has been taken. An assay made for Mr. Nicholson gave $480 per ton in gold. One lot of ore, amounting to 1,200 lbs., sent to the Selby smelting works, of San Francisco, gave a return of $127, and another lot of 100 lbs., $183 to the ton.

On the Old England, situated about two and one-half miles south easterly from the camp, $350 has been expended, sinking and timbering a shaft about 35 feet deep. The ore is similar to the Victoria.

The Slocan.—For the information of people on the coast, some of whom are densely ignorant about the Slocan, we would say that it is not a wheat raising country and farmers would do well to stay away from it. Capitalists will find it a bonanza, but the man in search of a place to plant corn and wheat had better go to the Okanagan. Silver, lead and hell are raised in the Slocan, and unless you can take a hand in the production of these articles, your services are not required.—*New Denver Ledger.*

MISCELLANEA

Speculation in Mines—Speaking of the revival of speculative interest in mining stocks during the past year or so, and especially in England, the London *Mining Journal* marks the distinction between the two classes of buyers and their different motives. "In the former case we have what may be termed commercial mining, undertaken in the same manner as any other branch of business, and we believe with as good an average prospect of success; and, in the other, speculative mining, in which profit is looked for, not so much from the mine itself, but from operations on the market, which may too often be described as sheer gambling." Perhaps the *Mining Journal* might do well to include a third class—those who buy to hold for dividends, but who do so without any intelligent understanding of the business, and whose investment is, therefore, a mere trusting to second-hand information, to the credibility of promoters, or to mere luck. This is quite as much "sheer gambling" as buying shares for a rise. But the *Journal's* estimate of the average prospects of legitimate mining, "undertaken in the same manner as any other branch of business"—that is, with full knowledge of the conditions and some insight into the character of the mining business—is entirely justifiable.

Condensation of Blast Furnace Fumes.—The condensation of dust and metallic fumes forms the subject of a communication by M. U. Le Verrier, Ingenieur-en-Chef des Mines. For blast furnaces the purification of gases has great importance, with a view to obtain the best results in stoves for heating the blast. Attempts have often been made to wash the gases by direct contact with water; but these methods appear to be generally abandoned. It is now sought to insure the cooling down of the outside of the pipes, and for this purpose suspended cast iron pipes, or squares made of hollow bricks, or very thin walls of cement strengthened by metal framework, are employed. For provoking the deposit of dust it was formerly sought to reduce the speed of the current by causing it to pass through chambers of large sectional area; but it appears that better results are obtained by interposing obstacles for increasing the surfaces of friction. Freudenberg was the first to apply this principle by placing rows of iron plates upright in the flues; and the wires suspended in the Tarnowitz conduits are perhaps still more efficacious and especially easier to manage. By increasing the number of obstacles it has been found possible to make a kind of filter; and at the De Wendel Iron Works, Hayange, Lothringen, the blast furnace gases are filtered across a bed of iron "straw."

Steel for Coal Tipples—The coal tipples of the future will be built of steel. The many tipples destroyed by fire, particularly the fine one burned recently in the Scott Haven district, have decided many operators on a verdict that the frame tipple must go. Selwyn M. Taylor has completed plans for a double tipple, to be built entirely of steel, and absolutely fire-proof, as the double flooring, which will be of wood, will be protected by asbestos. Work has been commenced on the foundation at the No. 2 shaft of the first pool, Monongahela Gas Coal Company, between Willock and Miller's Station, Pa., on the Baltimore & Ohio short line. The tipple will be 137 feet 6 inches long and 56 feet high. Cars will be hoisted 31 feet on an elevotor. The work of unloading the cars, dumping and running them back to the elevator will be all done automatically. Five men will be able to load 3,000 tons of coal in 10 hours. The cost of the structure will be about $20,000, which is 40 per cent. more than a frame tipple would cost. A tipple for a drift mine could be built for $5,500. There is nothing patented about the structure, and two small steel tipples are now in use. One is at W. B. Rend's McDonald mine, and the other on the Panhandle, owned by the Black Coal Company. The coal will be weighed after it is dumped into the cars. At present it is weighed in the screening pans. The upper part of the new steel tipple is protected by corrugated steel plates, the window frames being of wood. Many new devices in handling the cars have been adopted to lighten labor. The piers supporting the building and all the frame-work will be of very heavy steel, so that the motion of the cars in transit will not weaken it by vibration. There are now about 1,000 wood-constructed tipples in Western Pennsylvania. When these are destroyed or worn out, steel structures will replace them entirely, adding another to the steadily multiplying directions in which steel-makers are finding business. Insurance rates are very high on wooden coal tipples, owing to the destruction of so many by fire. The premiums paid are for hazardous risks. These fires are usually of incendiary origin. The steel tipple will not need any insurance, as nothing but dynamite can destroy it.

A New Safety Explosive—Professor F. Kleinpeter draws attention to a new mining explosive which is said to be coming into vogue in Austria. It is known as Dahmenite A, and is said to be 33 per cent. stronger than the best gelatine dynamite, and in consequence of the large volume of gas which it produces (being approximately double that yielded by dynamite) it has a weoging rather than a pulverising action resulting in a materially increased fall of lump coal It can be compressed without losing any of its explosive force, and in this state far surpasses every variety of dynamite. A much weaker detonator is required to bring it to explosion than any other known safety explosive, and it is better able to withstand the effects of storage. If properly packed no decomposition can take place. The last illustration of the safety with which Dahmenite A can be handled is the fact that the German Board of the State railways allows it to be carried in any trains, even in mixed passanger and goods trains. Extensive experiments are in progress in the several mining districts of the country, and when these have been completed no doubt we shall hear something further of the nature and properties of the new explosive.

Canadian Bar Iron.—The Hamilton *Spectator* says:—"The recent imposition of a higher duty on scrap iron, intended to encourage the development of the use of Canadian iron, is having its effect. The Ontario Rolling Mills Company has been putting in a puddling furnace with a capacity of four tons a day, and will puddle a special grade of iron from Three Rivers, said to be superior to the Norway iron—one of the best grades in the world. In case this new departure proves successful, it may have the effect of largely increasing the consumption of Canadian iron, and will tend to boom the smelting business." The pig iron to be used is "C.I.F." Three Rivers charcoal pig iron, an iron that at one time in the history of Canada was much prized for the manufacture of a special high quality of bar iron, equal in every respect to the best Swedish and Norway iron. The Ontario Rolling Mills Company have now made their full tests with splendid results, so that Canadian buyers will be able to get Canadian product in bar iron equal to anything made in the world.

Removal of Impurities from Iron during Casting—A novel apparatus has been devised by M. Riet to eliminate impurities from iron during the process of casting. In order to give the impurities time to separate from the melted iron before it runs in the mould, M. Riet sets on the top of the flask a sort of little bath tub, lined with some refractory substance, and presenting three cylindrical hollows of different sizes, communicating with each other by tangential channels. The iron is poured from the ladel into the large hollow, where it whirls around for a time and then escapes into the second basin, where it revolves in the opposite direction. From this it reaches the third compartment, which has a hole in the bottom, and, as this hole is set over the pouring hole in the flask, the iron then runs out into the mould. When the metal is poured into the large end of the tub, it is seen to whirl round until the surface is covered with the larger particles of impurity, which collect near the middle, the centrifugal force developed by the whirling serving to separate the purer and more liquid iron from the light and spongy scoriæ, very much as cream is separated from milk by a centrifugal churn, or molasses from sugar in the centrifugal tanks of a refinery. The operation is repeated in the next division, and, finally, the purified metal passes into the mould.

Compressed Air in Mines—At a colliery at Rleinvoigtoburg in Saxony a plant for compressed air is said to give excellent results, and as a few features in this installation are divergent and novel, it deserves more than a passing notice. At the surface there is a compressor of the type of an old model of the double acting wet compressor for compressing to 5 atmospheres or 75 pounds on the square inch. The air is now conveyed down the shaft into a main gallery where it is again compressed by a small single cylinder high pressure compressor and by this means the pressure is raised from 5 to 18 atmospheres.

Great advantages are claimed for the *high* pressure arrangement, as much smaller pipes are used for the transmission of the high pressed air into the workings.

The colliery is only a small one, and the steam engine working the surface compressor is only about 12 horse power, and the result is large pipes are not required. The main conducting pipe from the surface is only 3.14 inches in diameter, while the pipe for transmitting the high pressed air into the workings is only .98 of an inch in diameter.

The underground compressor is worked direct with an air engine and the work done by this plant is various and indicates a high useful effect ; for example, at the surface, compressed air is used to actuate a stone-breaker, and in the mine the same supply of compressed air from a 12 horse power steam engine, works a windlass, the air drills and an air locomotive that does the whole of the haulage.

The cost for the tramway installation, including the conducting or transmission pipes from the neighborhood of the shafts, to the storage tank for replenishing the locomotive at the distant end of the main haulage tramway was only $1650.00.

Boiler Firing by the Waste Heat of Coke Ovens.—Sixty new coke ovens of the improved Coppee type have recently been put down at the No. 2 shaft at the Prosper Collieries at Essen, Germany, of the Arenberg Gessellschaft für Bergbau- und Hüttenhetrich, while six tubular boilers of the Dürr type, each having a heating surface of 151·95 square metres, have also been laid down to utilize the waste heat from the coke ovens in steam-raising. The idea of utilizing this waste heat is not new at this colliery, as it had already eight Cornish boilers, each having a heating surface of 106 square metres, in operation, fired by the waste heat of a similar battery of coke ovens. The latter plant was experimentally supplemented by a Dürr tubular boiler, having a heating surface of 151·95 square metres, the results of which were so satisfactory that it was decided to put down six further boilers of this type. The arrangement of the boilers in connection with the coke ovens is in both cases identical. Several long tests were made as regards the evaporative capacity of the eight Cornish boilers, the average being 13¾ litres per hour and square metre of heating surface, the average initial temperature heing 300 degs. Cent. The makers of the Dürr boilers furnished the same under the following guarantee :—That four Dürr boilers must be operated with steam of the same dryness as with the Cornish boilers, and to show an evaporation of from 18 to 20 litres per square metre per hour. The first evaporation test lasted ten hours fifty-three minutes, and was so arranged that the coke ovens were then working under average conditions. The total water evaporated was 123,972¼ litres. This shows an evaporation of 18·738 litres per hour per square metre of heating surface. The average initial temperature was 275 degs. Cent. The second test was to ascertain the relative proportions of condensation water in the two batteries of boilers, the quantitative efficiency of the Dürr boilers being taken at 18·738 litres and that of the Cornish boilers at 13·75 litres per hour per square metre of heating surface. For this purpose large water-separators were introduced in the main steam pipes near to the branches to the different boilers. As a result of a ten-hours' test, it was found that the condensation water in the case of the Dürr boilers amounted to 732 litres, and in the Cornish boilers to 757 litres. It was further shown that, principally, insulated steam piping gave for 1 square metre of area ·554 litre of water condensation. The quantity of condensation water reckoned from the steam pipe area was :—

1. In the case of the Dürr battery...... .... 263·38 litres.
2. In the case of the Cornish battery.............. 291·112 "

There remained, therefore, water in the steam to the extent of—

In the Dürr boilers........... 732 — 263·38 = 468·62 litres.
In the Cornish boilers......... 757 — 291·112 = 465·888 "

The above figures give the following results :

1. In the case of the Dürr boilers,—

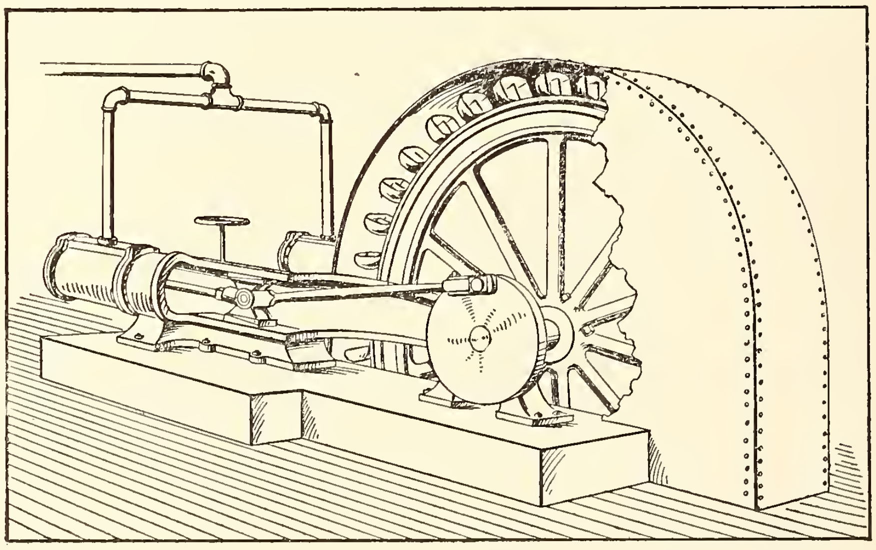
$$151{\cdot}95 \times 4 \times 18{\cdot}738 \times 10 = 113{,}889{\cdot}564 \text{ litres,}$$

so that the steam humidity $= \frac{468{\cdot}62}{1{,}138{\cdot}89} = {\cdot}411$ per cent.

2. In the case of the Cornish boilers,—

$$106 \times 8 \times 13{\cdot}75 \times 10 = 116{,}600 \text{ litres ;}$$

$$\text{steam humidity} = \frac{465{\cdot}888}{1{,}166} = {\cdot}3995 \text{ per cent.}$$



A Special Water-Driven Air Compressor.

Our illustration shows a special design of air compressor, which is intended for the utilization of mountain streams and other water powers having a high or medium head. The compressor proper will be seen to be of the standard duplex type, the special feature being the method of driving, which consists of the well-known Pelton water wheel mounted directly upon the crank shaft of the compressor. This method of driving is based upon the fact that the power of the Pelton wheel is dependent upon the size of its buckets and the diameter of the nozzle, and not upon the diameter of the wheel. It, therefore, becomes possible to adapt the wheel to the power to be developed, the speed of the compressor and the head of water under which it is to be placed, the number of revolutions of the wheel is determined by the compressor, whereas the peripheral speed of the buckets is determined by the head of water. It is hence only necessary to make the wheel of such a diameter that when running at the number of revolutions required by the compressor, the buckets shall have the peripheral speed required by the head of water. The spouting velocity of the water and the peripheral speed of the buckets increase much more slowly than the head; in fact, as the square root of the head, which fact enables the system to be adapted to an extremely wide range of head, with a comparatively small variation in the diameter of the wheel.

In point of fact the system is applicable for a range of heads between about 25 and 500 feet, the exact limit being in a measure determined by the size of machine contemplated. The machine from which the illustration was made, is at work under a head of 400 feet, which accounts for the large diameter of water wheel shown. Under lower heads, this diameter would of course, be less.

The advantages of this system are manifest at once. Its extreme simplicity renders it cheaper in first cost than any system of driving which involves transmission gear, and the absence of such transmission gearing means a further saving in transportation charges, which of course is a large item in mountainous regions. The water wheel acts also as a fly wheel, and thus the cost of transporting a fly wheel is avoided. There being no separate framework or foundation required for the wheel, the cost of transporting such framework and of building such foundation is also saved.

As shown in the illustration the wheel is covered with a casing made of sheet iron, but in points far removed from the place of manufacture, it is usually preferred to make this casing of boards on the ground, which method answers every purpose.

Where mule-back transportation must be resorted to, the machine is made of the sectional form, in which no piece exceeds the weight of 300 lbs., and it is under these circumstances that the small total weight of a compressor constructed on this system, is most apparent, and leads to the largest saving.

The machine described is manufactured by the Canadian Rand Drill Co., of Sherbrooke, P.Q. A large number of machines of the type here shown have been built by this company and its American parent with whom this system of driving is original. In sending inquiries for machines to be built upon this system, our readers should bear in mind that the head of water must be known, in order to determine the cost of the wheel, as in each case the size of the wheel has to be adapted to the head. Attention to this suggestion will in all cases save delay.

All inquiries sent to the Canadian Rand Drill Co. receive the most prompt attention, and when purchases are made from points far removed from the base of supplies, they make it a special point to leave nothing undone which can in any way assist towards making a plant which shall give long continued service with unskilled attention.

Underground Haulage.*

By A. Gardiner.

The cost of underground haulage of coal, forms a principal item in the cost of production. Yet, how many mining engineers and colliery managers are keeping pace with the age, in seeking the assistance of the various mechanical methods of motive power, which will meet the requirements in the many and varying circumstances that are to be met with in the mine? We are naturally of a conservative character, and unless compelled by force of circumstances over which we have no control, we are inclined to take matters in as easy a manner as is possible.

One of these unsought-for causes has come on us, and is arousing us to a sense of duty: depression; and a large portion of our very limited population are unemployed. These and various other minor reasons have influenced me to raise this question of underground haulage, that it may be discussed with profit to our members and the colony.

Closely associated with the subject matter is the above-ground haulage from pit mouth to ship side. It is not my intention to show how the Commissioners should reduce the haulage charge of coal, as it opens too large a question to be dealt with in a paper of this kind; but rather endeavor to show indirectly that these charges are too high, notwithstanding the recent reductions made in them. With only two exceptions, all the collieries under eight miles from the dyke pay 10d. per ton f.o.b.; that rate has been in existence for some 15 years. On an average it is about 2d. per ton per mile; the trader supplies his own waggons. Where waggons are provided by the Commissioners an increased rate is charged. The minimum distance is too high; in fact, is much higher at present than it was in Scotland some 12 or 14 years ago. When we take into consideration the vast improvements made in the permanent way, more powerful locomotives now in use as compared with 12 years ago even in Great Britain, the cheaper and more economical method of working the traffic by the aid of the telegraph and telephohe, it could be contended there are good grounds for some reduction in the present charge; but, as above stated, it is not the design of this paper, except indirectly, to show how these charges should be reduced.

It is proposed to investigate underground haulage, its improvements and reduction in cost, and to demonstrate advantages to be derived both from these improvements and those arising from recent inventions for economical working of the railways.

Having thus defined the duty we have undertaken, we may not only enquire into the present state of haulage underground, but review the progress of recent years, and note the methods by which economy has been affected; whereby we shall be assisted to make further progress on more economical lines.

Let us first take a view of perhaps the earliest system of underground transit and most certainly the rudest. This was the bearing system, which was in existence in places in Great Britain up to about 60 years ago, and by which the coal was removed from the working face in the mine so the surface. Boys, young women, and mothers carried the coal in baskets or creels, precisely in the same fashion that fishermen's wives in the east of Scotland carried their fish to market.

All the plant necessary for carrying the coal underground by this system was a basket capable of carrying from 1½ cwt. to 2 cwt., and a strap or broad belt of sufficient length to pass from one side of the basket to the other, and around the forehead of the bearer, when the basket was on the back; these were provided by the bearer. The cost by this mode of transit underground and up to the surface was from 2s. 10d. to 3s. 3d. per ton per mile. When it is stated that the conveyance of coal by this system 8,400 yards with a perpendicular height of 700 yards was a woman's work for 8d. per day, or 3s. 3d. per ton per mile, it will enable you to realize the difference of work in the mine to-day compared with the beginning of this century.†

The first step towards the improvement of this brutal system was the introduction of the sledge system.

The name sledge was given to a box with two runners under it, like a cradle, with a capacity varying from 1¼ cwt. to 5 cwt. These runners were sometimes shod with iron straps, acc rding to the nature of the floor they were to be run on. The sledges were drawn along the natural floor of the mine by men, boys and women; where animal power could be applied it was done. When manual power was used, a set of harness was put on, which consisted of two straps of leather passing over the shoulders, the four ends being connected together by a chain attached to the sledge. The cost of sledging the coal entirely by manual labor, averaging it over both level and inclined roads, was 9s. 6d. per ton per mile; 2s. 6d. day's wage. The introduction of wooden rails, with in cases a strap of iron nailed to them, particularly on the level roads, removed much laborious and exhaustive work. Cost also was much reduced, being about 3s. 8¼d. per ton per mile, with the day's wage at 4s.

With the introduction of rails came wheel vehicles in several forms before the present skip was developed; wheel-barrows; a four-wheel tram or bogie to carry baskets on and save the inconvenience felt in the transfer of the coals from the barrow into the baskets or tubs in which the coal was taken up the shaft. These barrows and four-wheel trams, or bogies, were run on planks, generally three, the upper one forming a guide for the wheels.

The date of the first introduction of wooden rails and sleepers was about 1632. The certain account of cast iron rails being used experimentally was 1767. The earliest notice of malleable iron rails being used was in the beginning of this century, 1805.

The general introduction of rails into the mine did not, at first, very much modify the arrangements for collecting and conveying the coal from face to surface; it only developed the tram or bogie system, whereby the baskets filled at face were conveyed and sent up the shaft. To protect the coal in its transfer from the tram to tub, and its haulage to the surface, a system of conductors was devised which consisted in iron bars connected together with links or screws. Ultimately we arrive at the state when the wheeled vehicles were sent to the surface on cages or platforms with permanently fixed winding ropes on them, guided up the shafts by the conductors. These guiding conductors in the meantime also passed through several stages of improvement—iron bars; wooden (pitch pine); malleable iron bridge and web rails; and, lastly, specially made wire (steel) ropes.

With these latter improvements the modern skips came into existence. The capacity of the "hutches" of Scotland, or skips of our district, has been controlled by local circumstances and by the customs of districts. For this reason the writer will follow up that with which he is most conversant, as the result will be the same. Before legislative enactments came into existence compelling all coal to be weighted, the collier was paid for "per cart," which was recognized as 21 cwt. gross, containing 16 cwt. round coal and 5 cwt. slack or dross. This quantity was filled in three "hutches," each containing about 7 cwt. These "hutches" tared about 2½ cwt. each, and sold in the same manner. This being the case, the "hutches," *i.e.*, the skips, of Scotland, were as a rule tubs capable of carrying 7 cwt. to 8 cwt. of coal, gross about 10 cwt. The underground ways constructed to carry this weight were of angled cast-iron rails in about 4 ft. lengths, weighting about 50 lb. to 60 lb. per square yard, with sawn sleepers (pine) 2½ ft. x 5 in. x 2½ in. to 3 in. The cost per mile was about £220, including labor in laying. The general introduction of the malleable iron rail, though the cost per mile was about the same, involved the use of a lighter rail, and did away with the breakage trouble that was so common with the cast-iron rail.

With skips, as above described, in tare with a gross load of half ton where the inclination of the seam was almost horizontal, wheeling from face to flat was done by youths and men, and from the flat to bottom of shaft by horses; the average distance travelled per day was about 5,000 yards; and the cost per ton per mile 2s. to 3s. 2d. In mines with the strata inclined about 1 in 6, the distance travelled averaged about 4,200 yards per day, and the cost per ton per mile was 2s. 4d. to 4s. In mines where the load is upwards, or the roads were badly laid and of uneven gradients, the average daily distance travelled was 2,200 yards, the cost per ton per mile being 4s. to 7s. An instance from another district under somewhat changed conditions: With the seam inclined 1 in 12 to 14, and skips about the same tare and gross, the distance travelled on roads uphill was about 170 yards, and on level roads 230 yards, or 400 yards in all. Average cost per ton per mile, 1s. 3¾d. Another case: Roads uphill, 250 yards; distance travelled on the level, 380 yards; total, 630 yards. Average cost per ton per mile, 1s. 7d.

The owners of the famous gas-coal works in Lanarkshire, at the time when underground haulage was as above described, made an effort to make a reform in this item of cost. The position of affairs before the reform was instituted was as follows:—The average length of the level roads was 376 yards; the average length of the roads uphill was 120 yards. The greatest distance travelled by a wheeler per day, taking one fortnight's work, was 9 miles 91 yards, or a general average of 6 to 7 miles. this includes going in with empty and returning with full trucks. Average cost per ton per mile was 1s. 4d. to 2s. 6d. when 4s. per day was paid to the wheeler, and 2s. to 3s. 8d. per ton per mile when 6s. per day was paid to the wheeler. The reform consisted in making the underground railway as follows:—The main roads were laid with malleable iron edge rails 2 in. x ¾ in. thick, notched into sleepers (intermediate) with cast iron chairs at the joints. In laying the rails the joining of opposite rails were never made on the same sleeper. On the roads uphill the iron bars were 2 in. x ⅝ in. thick. The cost of one mile of this railway was £300. The capacity of the skip was increased to 13 cwt. coal, its tare being 4½ cwt.; wheels 12 in. diameter, cast iron for edge rails. Horses were introduced to take the full load from flats to bottom; ponies to take empties into faces; manual labor only being used to run full skips from face to bottom of inclined roads. Manual labor, viz., running out full skips from face or bords to foot of rise roads and walking back to face, was paid for at the rate of 1·5d. or 16·6d. per ton per mile. For work done by ponies in taking empties into the faces and returning empty (the average distance travelled being about seven miles per day), the cost was 2·5d. per ton, or at the rate of 23d. per ton per mile. For work done by jig-brow or incline, full skips bringing up the empty ones, 1·6d. per ton, or 8·7d. per ton per mile was the cost. For main roads by horse travelling 12 to 14 miles per day ·8d. per ton, or at the rate of 2·6d. per ton per mile. The total cost per ton by horse labor was 6·4d. per ton, or at the rate of 1s. 1½d. per ton per mile, the average length of roads being about 836 yards.

The average cost by manual labor previous to the change was 9·6d. per ton, or at the rate of 2s. 10¼d. per ton per mile; but at that time the distance the coal was conveyed was considerably less, being only an average of 496 yards.

The writer has by him the actual cost of two pits in another district than that given in Scotland. At the first pit 49 men wheeled 400 yds. 2,912 tons, at a cost of £54 6s. 2d., or 12·64d. per ton per mile; and 34 men wheeled 800 yds. 2,022 tons, at a cost of £37 14s., or 9·84d. per ton per mile; thus giving an average cost of 11·24d. per ton per mile for the 4,934 tons, one month's work. At the second pit 45 men wheeled 300 yards 2,641 tons, at a cost of £36 16s. 6d., or 19·63d. per ton per mile; and 52 men wheeled 650 yds. 3,046 tons, at a cost of £42 9s. 5d., or 9·06d. per ton per mile; thus giving an average cost of 14·34d. per ton per mile. The cost of labor is based on the following prices, viz.: horse feed, 3s.; drivers, 3s.; hangers-on, 3s. 6d.; road men or deputy, 4s.; wheelers, 4s. per day.

The following is the cost of a colliery in Staffordshire, England, which may be taken as a fair example of the cost of haulage at the date under consideration (1861):—345 tons 12 cwt. wheeled 645 yards, *i.e.*, average distance, at a cost of £8 4s., or an average of 15·55d. per ton per mile. The prices paid for labor were as follows: Horses, 6s. 6d.; drivers, 2s.; roadmen, 4s; horse groom, 3s. 6d.; hangers-on, 3s. 6d., per day.

Thus we may sum up this section of our subject by stating that from experience we have particularly to note that improvements in the road, in the size of the skip, and in the motive power, have enabled a more economical cost of working to be arrived at. This has been evidenced from actual facts of cost. At each successive stage of advance an economy has been effected. And again, as progress was made in the motive power, another reduction was effected.

*Paper read before the Northern Engineering Institute of N.S.W. (Newcastle).

† These figures are on the authority of Messrs. Dunn, Government Inspector, and M. Ball, Mining Engineer, Alloa.

On the Estimation of Sulphur in Pyrites. *

By G. Lunge.

Under the above title, Mr. T. S. Gladding (The Journal, June, 1894), has published several modifications of the wet assay of pyrites which call for some comment on my part, since these modifications purport to be improvements on my method, contained in the "Alkali-makers' Handbook," and extensively employed in all countries.

Some of Gladding's modifications are of a less important character, and these can be passed in review very briefly. He does not, like myself, test the sample with its natural moisture, estimating the latter in a special sample, but he dries the whole sample and weighs it out in that state. He employs a whole gram of pyrites, I only half a gram; and I do so purposely, because the washing of the precipitates is much easier, and consequently the results are more reliable with the smaller than with the larger quantity. In lieu of the mixture of acids employed by me (three volumes of nitric acid of sp. gr. 1.42 and one volume of fuming hydrochloric acid), Gladding decomposes the pyrites with a solution of bromine and nitric acid. The prescription for that solution is not correct as printed, for seventy-five grams of potassium bromide cannot possibly be dissolved in fifty grams of cold water, or anything like that quantity, but this may be a clerical error, which does not matter very much, as ultimately the solution is diluted to 500 cc. I will say at once that the bromine solution works well, but no better than the acid mixture according to my prescription.

A more important modification is the following: It is well known that in the presence of iron the precipitate formed by barium chloride in a solution of sulphates

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cannot be freed from iron, and that the results of the estimation of sulphur in this case are too low; in my publication of 1879 (*Ztschr. anal. Chem.*, 19, 419) I found on the average 0.19 per cent. too little sulphur, unless the iron had been previously removed from the solution. Fresenius has also worked on this subject, and Jannasch and Richards, in 1889, completely elucidated it by proving that a double sulphate of barium and iron was formed in this case. Gladding gives a similar explanation, without mentioning the more complete investigations of his predecessors, which would have saved him the trouble of working out the matter for himself. I had already long ago dealt with that difficulty by proposing, in 1889, that method which was afterwards embodied in the "Alkali-makers Handbook," viz., precipitating the iron by ammonia, washing the ferric hydroxide, and precipitating the sulphate in the filtrate by barium chloride. Gladding asserts, however, that "the most careful washing failed to wash out all the sulphur from the ferric hydroxide," and he therefore proposes to wash the hydroxide as well as possible and to dissolve it afterwards in diluted hydrocloric acid, thereupon treating that solution with barium chloride; evidently with the tacit assumption that the small quantity of sulphide present in that solution is accurately enough estimated as barium sulphate, in spite of the large quantity of iron present; but that assumption is far from self-evident, nor does it actually represent the truth, as we shall see.

It is quite evident that Gladding, although he knows and quotes the "Alkali-makers' Handbook," and although he entirely adopts the prescription given there (page 93) for the *precipitation* of the ferric hyroxide, which deviates not unessentially from those previously given by Fresenius and others, has not completely followed the instructions for the *washing* of the precipitate given immediately after in the following words: "Filter hot, and wash on the filter with hot water, avoiding channels in the mass, but so that the whole precipitate is thoroughly *churned up* with the water each time." Many hundreds of pyrites tests made in my own and other laboratories have proved that by following the above instructions the washing of the ferric hydroxide is accomplished in from half an hour to an hour, that the number of washings need not exceed five, and the bulk of the liquid, apart from the original filtrate, need not exceed 100 to 150 cc., and *that no trace of sulphur is left in the ferric hydroxide*, as evidenced by drying the precipitate, fluxing it with pure soda, dissolving it in water, and testing the solution for sulphate. It is true that the students in my laboratory have sometimes failed to get out all the sulphur, but in *every* case through having washed in the usual way, instead of that described above; and the same men have succeeded in *every* case, after their attention had been drawn to this point.

There is another difference between Gladding's and my own manner of proceeding. I prescribe heating the solution of the sulphate to the boiling-point, as well as that of the barium chloride, adding the latter to the former all at once, allowing to stand for half an hour only, and then at once filtering and washing while the liquid is quite hot. I had convinced myself that under these circumstances the precipitate filters most easily and no barium sulphate whatever subsequently separates from the filtrate. Gladding, however, not merely adheres to the old and useless prescription of letting the liquid stand over-night after the precipitation, but he adds to this a novel and most tedious way of effecting the precipitation, viz., adding fifty cc. of barium chloride solution quite slowly, one drop per minute. This will take about an hour, instead of a few seconds, as in my method.

I considered it my duty to find out whether the method recommended by Gladding is better than mine, or inferior to it, or equivalent with it; and in the last case, which of the two is easier and quicker to execute. For this purpose a sample of Spanish pyrites was selected which was triturated as usual and mixed in the most careful manner. The tests were made by one of my demonstrators, H. von Keler, under my constant personal supervision. First of all the sample was tested exactly according to the method laid down in the "Handbook," with the following results: 50.17; 50.42; 50.20; 50.23; 50.19; average, 50.24 per cent. The insoluble amounted to 1.42 per cent.; the moisture to 0.47 per cent. I abstain from reducing the percentages to the dry state, as being unnecessary in this case.

As the next step, a number of samples were decomposed by Gladding's mixture of bromine solution and nitric acid. We found his prescription in this item to be perfectly correct; it is not feasible to hasten the process (which is much lengthier than that used by myself), for instance, by filling the water-bath from the first with hot water. Any attempt to do such a thing ends in an over-violent reaction, and a loss by spurting and separation of free sulphur. We tested, of course, our bromine and potassium bromide, and found them quite free from sulphuric acid.

Three of the samples thus decomposed, according to Gladding, were precipitated exactly according to his method (one hour's precipitation, twelve hours' settling), another three samples according to mine (precipitating all at once and filtering after half an hour). The results were:

Gladding's Method.	Lunge's Method.
50.24	50.24
50.24	50.22
50.30	50.28
50.26	50.25

We see that both methods of precipitation give identical results, and these also entirely agree with the tests made from the first according to the "Handbook" method, viz., 50.24. The conclusions to be drawn therefrom are: 1. Since both methods of precipitation yield the same result, my expeditious method of precipitation and filtration, which, inclusive of washing, takes about an hour, is preferable to Gladding's method, requiring about twelve hours. 2. Since Gladding's bromine method for decomposing pyrites yields results identical with that prescribed by myself, there is no reason for abandoning the latter and adopting a more tedious method, unnecessarily employing such a disagreeable re-agent as bromine.

I understand from a private communication of Mr. Gladding's that he attributes the greatest value to his manner of precipitating the barium sulphate, and that in his opinion by operating in my way barium chloride is always carried down with the sulphate, making the results too high by 0.20 to 0.40 per cent. It would have been most remarkable if that point had been overlooked in the many thousands of tests made according to my methods by perhaps a hundred different chemists; but in order not to incur any reproach, I had this point put to another searching investigation. Mr. W. Jackson made five most careful tests of another sample of pyrites, decomposing and otherwise treating them absolutely in the same way, but making the precipitation in two cases by Gladding's, and in three cases by my method. The results were:

Lunge's Method.	Gladding's Method.
50.59 per cent.	50.60 per cent.
50.63 "	50.66 "
50.56 "	.... "
Average, 50.59 "	Average, 50.63 "

This affords another thorough refutation of Gladding's assertion.

In all analyses made up to this point the ferric hydroxide had been precipitated and washed five times, exactly in the way described by me; in every case it had been afterwards tested by fluxing with soda, but no trace of sulphur had ever been found. This furnished an additional (although unnecessary) proof that Gladding's assertion in that respect is equally unfounded, and that the treatment described by him (dissolving the ferric hydroxide in hydrochloric acid and precipitating by barium chloride) is quite useless, when observing the precautions in washing, pointed out by me. Still I thought it advisable to find out how Gladding's process would work in cases where, by some mistake, a little sulphur had been left in the hydroxide, and I grant that in important cases the latter ought to be tested in some way or another for any sulphur left behind. I further grant at once that in this case Gladding's method, as described, is more expeditious than mine: drying the ferric hydroxide, detaching it from the paper, mixing it with pure sodium carbonate, fluxing it in a platinum crucible (in such manner that no sulphur from the gas can get into the mass, *e.g.*, in a hole made in asbestos cardboard), dissolving in water and precipitating the sulphur by barium chloride. It is hardly necessary to say that I did not choose this plan without first considering the very simple method described by Mr. Gladding; but I rejected it, since Fresenius had proved that barium sulphate is very distinctly soluble in an acid solution of ferric chloride. But as Gladding now asserts that the direct solution of the ferric hydroxide in hydrochloric acid yields accurate results, it became incumbent on me to examine this statement.

Eight samples of our pyrites were decomposed, and the ferric hydroxide was precipitated under absolutely equal conditions of dilution, temperature and quantities of re-agents. The washing was purposely not continued as far as it ought to have been; and as some previous experiments had shown that no uniform degree of exhaustion can be attained by incomplete washing, we estimated in all cases the *total* sulphur, separating, of course, that which was found in the filtrate and that which was left with the ferric hydroxide. Four of the eight samples were treated by Gladding's prescription, and four by my own system. The results were:

Lunge (fluxing with sodium carbonate).			Gladding (dissolving in hydrochloric acid).		
Filtrate.	Precipitate.	Total.	Filtrate.	Precipitate.	Total.
49.64	0.60	50.24	48.98	1.03	50.01
49.36	1.01	50.37	48.84	1.39	50.23
49.07	1.21	50.28	49.02	1.07	50.19
49.25	1.04	50.29	49.30	0.73	50.03
Average,		50.29	Average,		50.09

This proves that Gladding's method does not, in this particular, give accurate, but *low* results (by 0.20 per cent.); with less complete washing the discrepancy would evidently have been even greater. The total sulphur found by my process, on the other hand, agrees quite satisfactorily with the correct analyses quoted before.

The final conclusion of this investigation must be: That in most points Gladding's method is correct, but in *not a single case* more so than my method; his modifications can not be approved, as they greatly lengthen the time required for the analysis, without any corresponding advantage whatever. In one point which forms the principal novelty in Gladding's process, he is decidedly *wrong*. It is not true that it is unavoidable to leave any sulphur in the ferric hydroxide; on the contrary, this is very easy to avoid. If it has, after all, happened by incorrcet manipulation, Gladding's plan will *not* get out all the sulphur, but my plan (fluxing with soda) must be adopted.

I have shown that there is not a single point recommended by Gladding, in deviation from my method, which is fit for adoption, and I must conscientiously advise my brother chemists to adhere to the method just as I have laid it down in the "Alkali-makers' Handbook."

In conclusion I would add that I have also tried the method recommended by F. Johnson (*Chem. News, 1894*, 70, 212), omitting to precipitate the iron, but reducing it by sodium hypophosphite to the state of protochloride. Even when working precisely as described by the author, the results were so widely off the truth, that I can make nothing whatever of this plan.

Steel Structures for Collieries.*

By Harry J. Lewis.

The very material reductions which have taken place in the price of structural steel work during the two years just past place within easy reach of mine operators a type of outside equipment which has heretofore been considered a luxury. Some of the first experiments in the use of steel structures have not been entitrely satisfactory, because the purchasers did not place the matter in competent hands, and in consequence obtained in some cases a framework which was ill designed and entirely too light for the work it had to perform. In other cases they were loaded up with a lot of unnecessary material. The first case is by all means the poorest bargain of the two, as the apparatus never gives satisfaction from the very first day it is put in service, and its cost is very little less than that of a good one. It takes practically the same number of columns, beams, bracing, roof trusses, &c., for a light structure as for a heavy one, and a comparatively small amount of additional material enables the designer to obtain the benefit of much larger and much stiffer sections. It is an axiom among engineers that a structure which is too heavy in all its parts never gives any trouble except through a slightly increased interest charge on plant, and this is, therefore, not a serious fault if the extra material is kept within reasonable bounds.

The service strains developed in a head frame or tipple frame are of such a character as to render their exact determination difficult, arising as they do from a combination of static and dynamic loads. A good instance of this sort is where the throttle of a first motion hoisting engine is pulled wide open at the beginning of the lift, in which case the strain in the hoist rope while the load is being started is often more than twice the static weight of cage, tramcar and load. This strain must be transferred from the head sheave through the different members of the head frame to the foundation, and the designer who fails to take account of this extra load will not get a stiff structure.

Another thing which should not be neglected is that the horizontal component of the strain in the portion of the hoist rope leading from the head sheave to the winding drum varies from its maximum to almost nothing every time a load is hoisted rapidly and dropped upon the cage keeps at the top. This strain also alternates from side to side of the head frame with each lift, and sets up a combination of racking and twisting strains which must be taken into account if a stiff and durable structure is desired. In attempting to provide for these strains the author has found it advisable to do away altogether with adjustable rods in the bracing, and use stiff members throughout, with solid rivet connections. This avoids entirely the necessity of continually screwing up sleeve nuts or turn buckles, and any engineer who has had experience in the adjustment of bridges will hail with delight any device which will relieve him from the horrors which may be perpetrated with a monkey wrench in unskilled hands.

Some of the first steel head frames turned out badly because the arrangement of

* Paper read before the Ohio Mining Institute.

the supports for the head sheave bearings were copied from the older wooden type, in which the tops of the columns were subjected to transverse strains in addition to their legitimate work. In consequence of this the columns' heads deflected every time a lift was made, and threw the bearings out of level, thereby causing them to cut and give trouble generally. In endeavoring to correct this feature, the author has devised an entirely different arrangement of head sheave supports, in which each member has its own legitimate work to perform and is proportioned for the load transmitted as nearly as this can be determined.

A word as to the proper inclination of the hoist rope between the head sheave and winding drum may not be out of place, as in case the angle is too steep there is a considerable force acting to lift the winding engine vertically off its bed, and if too flat the racking tendency on the head frame is equally destructive. The best results appear to be obtained by using inclinations varying between 35° and 50° with the horizon.

In taking up the problem of strains in the tipple frame, the author finds that in this also the horizontal strains need to be provided against very carefully. These arise from suddenly stopping on the tipple horns a load of from 2 tons to 4 tons moving at a speed of 1 foot to 5 feet per second. Probably the best plan for handling this is to provide a heavy floor on the level of the dumps and firmly attached to them, the proportionately greater mass of which first receives the shock and lengthens the period of time of transference into the framework and thence to the foundations. In order to provide space for the passage of the trams under the tipple, the columns must be left unsupported in the direction of the greatest strain for a height of 8 to 10 feet from the bottom. They are therefore subjected to transverse strains, and must be proportioned accordingly. The author is free to admit that this is largely a matter of judgment, and the proper proportions can only be arrived at by experience. This difficulty can be obviated in some cases by attaching the tipple to the head frame, which latter should always possess a complete system of longitudinal bracing clear to the bottom. In some other cases a panel containing complete bracing can be placed in the rear of the span over the tracks, but for the most part this latter plan is more expensive than to enlarge the main columns and beams.

Simplicity of design both in main members and connections should always be aimed at in a tipple frame, so as to render easy any changes in screening apparatus which the varying demands of the trade may require. The tipple house should consist of a steel framework and covering throughout, no wood being allowed except in doors, windows, partitions, and floors. Wood should never be used in such a manner that the stability of the structure would be impaired by burning it away entirely. Absolutely fireproof construction is not an economical possibility at present, but the danger from fire can be greatly reduced by proper designing.

The roof and siding should be of heavy corrugated iron, rivetted fast by means of metal clips to steel purlins and side girts. It is the poorest sort of economy to use a lightweight sheet in the covering, and the author would recommend that nothing lighter should ever be used than No. 20 for siding and No. 18 for roofing. For structures intended to last in one place for 20 or 30 years heavier sheets than the above can be used to advantage, as the extra expense is mainly in the added weight of material.

Another thing which should be looked out for where possible is the introduction of a fire insulating space between tipple and head frame, tipple and shaft opening, or tipple and slope mouth. This space should be at least 10 feet or 15 feet wide, and across it no continuous line of inflammable material should be allowed to exist; not even those two streaks of oil which seem to follow wherever a mine rail is laid.

The use of screens, chutes, hoppers and pans made entirely of metal has become so nearly universal that it is hardly necessary to say anything in their favor. Some makers of this class of equipment have, in their efforts to cheapen it, used material which was altogether too light, and scattered their rivets so far apart that they were hardly on speaking terms with each other. This policy is certain to result in an equipment which is a rattletrap at first and a wreck before it has had a chance to get old. The dump plate at the head of the screen should be from $\frac{5}{16}$ inch to $\frac{3}{8}$ inch thick, so as not to be dented by the fall of the coal. All other bottom plates over which the main body of the coal runs should be from $\frac{1}{4}$ inch to $\frac{5}{16}$ inch thick. The sides of main screens and chutes may be from $\frac{1}{16}$ inch to $\frac{1}{8}$ inch thinner than the bottoms, as they do not receive the scour of the coal to the same extent. The bottom of the sides should be joined by angles with a thickness equal to the thickest plate, and with flanges wide enough to take $\frac{1}{2}$ inch or $\frac{5}{8}$ inch rivet driven hot. Where necessary, the top edges should be stiffened by similar angles. The pitch of rivets should not be ordinarily more than 6 inches and in very thin plates less than this. For the nut and slack chutes $\frac{3}{16}$ inch and $\frac{1}{8}$ inch plate may be used, as these handle only a small percentage of the coal, and are therefore less subject to wear.

There are but few cases where the engineer in charge of a new opening will find it difficult to provide plenty of height from dump to railroad tracks, and it is to be regretted that so many mistakes are made on this point. This height depends on the number and kind of separations that are to be made, and the screen plan should be carefully worked out before the general plan of opening is finally decided on. A failure to do this has often resulted in a fixed charge for elevating, &c., which in view of the narrow profits of mining should always be avoided where possible. For a modern apparatus making three separations, viz., lump, nut and slack, it is safe to assume that this height should never be less than 30 feet. Many of the older types having a height of 26 and 28 feet, and which were all right in their day, are now giving a great deal of trouble because their discharge chutes will hardly clear the tops of the new gondolas, and trimming the coal to a neat ridge is not to be thought of.

Great latitude is required of an apparatus which is to load neatly, and with minimum breakage, all cars which may come to it at the present time. A table of extremes in dimensions of cars is approximately as follows: Floor to rail, 3 feet 8 inches to 4 feet 3 inches; top to rail, 6 feet 6 inches to 8 feet 6 inches; extreme width, 9 feet 3 inches to 10 feet 6 inches; length over all, 20 feet to 36 feet. Sorting these cars so as to give an hour's run on a similar kind is not to be thought of, and the apparatus must pounce on high and low alike without so much as letting out a rod or taking up a chain.

It is not an easy matter to give an idea of the cost of metal as compared with wood, for the reason that when the purchaser has made up his mind to use metal he demands a better apparatus in every way than he could possibly get in wood. Taking this into account, the advance over the price of wood will probably average 50 per cent.

Among the advantages which a properly designed metal structure has over a wooden one are these: Comparative safety from fire. The bill for pumping alone in some mines while replacing a burned out tipple would more than pay the difference, to say nothing of other losses. Durability: a metal structure which is heavy enough for its work is much more durable, on account of its greater elasticity, which enables it to sustain shocks without permanent deformation. In consequence of the above a good metal concern should last 20 or 30 years, even if taken down and put up in different locations, while a wooden one which has seen six or seven years' service is not worth taking down, much less putting up again.

In conclusion, it may be said that as the tipple is the focus towards which all the other operations of the mine are directed, and through which all the product must pass, the progressive operator will see to it that it is of the best and most durable, both as to material and design.

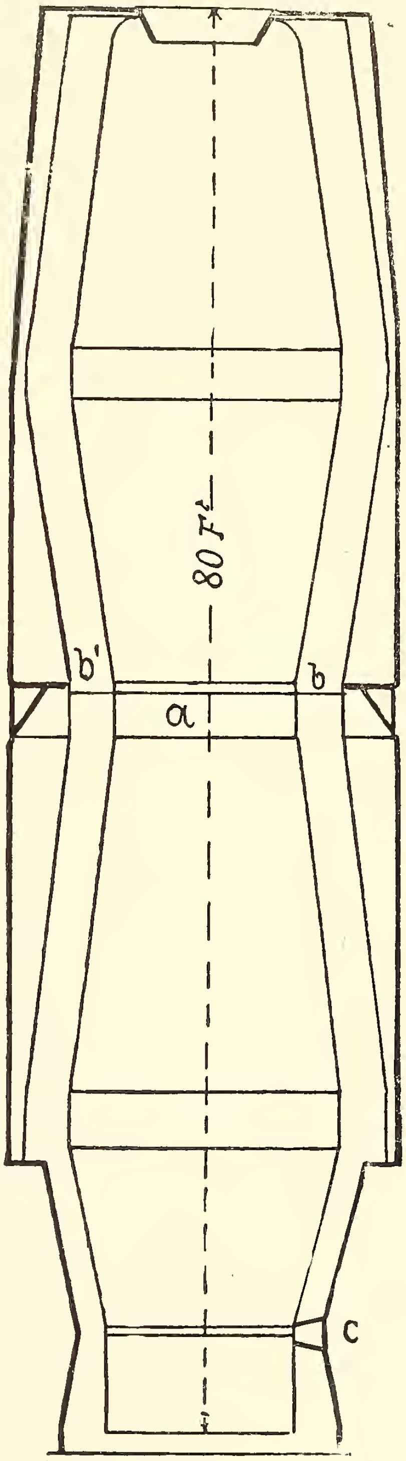
New Lines for Blast Furnaces.

J. W. Thomas, Catasauqua, Pa.

That which chiefly interests blast furnace managers during times of cheap iron is how to produce the largest output of merchantable pig iron with the least consumption of fuel. Any reasonable suggestion to this end is eagerly examined, and if found to contain merit, experimented with, and if successful, adopted. All suggestions offered, however, are not feasible, and many go no further than the suggestor.

I have a suggestion to offer to this end, which, I believe, has merit, and which, I think, will accomplish all that is claimed for it. The plan has been submitted to several successful furnace managers, and received their unqualified approval.

The departure I advocate would be new lines for the furnace, as per accompanying illustration, with the aid of superheated steam. In this illustration is represented an 80-foot furnace constructed on the lines I suggest, in which A is the neck, *b* b^1 steam inlets, and C the tuyere line.



By changing the lines of the furnace to the above shape, I think the consumption of fuel in the blast furnace will be reduced considerably. The main departure is the blowing of superheated steam into the furnace at the neck at *b* b^1, the amount to be regulated by the working of the furnace. The reduction of the ores will begin at this point and continue downward. The stock passing through a larger area of high temperature, and in a greater zone of reducing gases, under a high pressure, caused by the gases contracting at the neck, will enable the chemical reactions to take place under more favorable conditions.

The superheated steam, coming in contact with the heated stock, will form gases having higher reducing properties, and also furnish abundant gas for stoves, boilers, and other purposes. There will be an expansion of the gases after passing through the neck, causing combustion, which will prepare the ores more advantageously for the action of the gases in the lower zone.

Openings in the shell at the neck large enough to give easy access for the regulating of the superheated steam, etc., would be required. The neck can be protected by water plates of any desired pattern.

Underground Pumping in Westphalia.

A. Demmler, in the *Bulletin* de la Société Minérale, describes the underground pumping engine of the Hugo mine, Westphalia. The Hugo mine, near Buer, in Westphalia, which was opened by a Lyons company, and passed into German ownership in 1889, is one of the most prosperous of the Westphalian collieries, in spite of its great depth. It has two pits at work and a third in process of sinking. The oldest and deepest of these, No. 1, works the coal in the bottom of a basin at the depth of 644 yards, while No. 2 cuts the same seams on the northern rise at 517 yards, at a distance of 1,000 yards from No. 1, while the new pit, No. 3, is intended to reach the measures on the southern rise. The flow of water into the workings amounts to about two tons per minute, but this quantity is likely to increase considerably with the extension of the workings, particularly to the eastward, in which direction it has already been necessary to put in several dams pending the erection of new pumping machinery. As the surface arrangements did not admit of putting a second main rod in the principal pit, it was decided to use underground engines, forcing the water to the surface in a single lift. Owing to the loose character of the ground at the bottom of the mine, it has, however, been necessary to place the engines at a considerable distance, about 280 yards from the pit bottom, and about 25 ft. above it. The sump water is conveyed by a siphon, 235 yards long, to a lodge level at a depth of 652 yards from the surface, placed immediately below the engine room floor. The engine, of the horizontal compound type has two cylinders of 700 and 1,150 mm. diameter, and 1,200 mm. stroke, their relative capacities being as 1 to 2.75. The forward end of the piston rods are coupled at right angles upon the same flywheel; the back end of the high pressure engine works two plunger pumps by a three armed lever, which raises the water from the bottom level to the feed cistern of the plunger pumps, a height of 45 feet. The steam from the low pressure cylinder and the jackets is condensed by the water lifted by these pumps, which, therefore, also do duty as air pumps for the condenser. The temperature of the water in the sump is 22 degs. Cent., which is raised to 35 degs. after passing the condenser, and to 40 degs. in the feed cistern of the plunger pump. As the quantity lifted, 3·8 tons per minute, is in excess of that forced to the surface in the same time, 2·4 tons, the difference, 1·4 tons, returns to the sump by an overflow pipe. This arrangement is necessary on account of the large quantity of water required by the condenser, the vacuum obtained being nearly absolute.

The force pump attached to the low pressure cylinder is double acting, on Girard's system, having two single acting plungers on the same rod, their diameter being 192 mm. and that of the rod 100 mm. The pump barrels are of cast steel and the plungers and their rods of delta metal. The valves on Fernies' patent have four annular passages formed of conical bronze rings, the valve plates being built up of a lower conical ring in bronze, and an upper cylindrical one in iron with a well tanned leather disc between them, which is slightly cupped so as to close the passage when the return pressures are applied. Air vessels are applied over each valve box, in addition to a large one which is placed at the bottom of the rising main. This is made of sheet iron, and is 28 in. internal diameter and 12 ft. high, and is supplied with air from a special air compressor. The rising main of 9¼ in. inside diameter has a total length of 1,027 yards, with a vertical rise of 641 yards, the difference representing the length of the drift between the engine room and the shaft. The steam pipe, of about 1,100 yards total length between the boilers and the engines, is of 9½ in. diameter, and is carried down the pit and along the connecting gallery side by side with the rising main, provision being made for expansion by sliding joints in delta metal in the pit, and curved copper pipes on the level. The pipes are in 13 ft. lengths, united by flanges with packing rings of india rubber in the joints, the asbestos packing originally used having been found to harden and crack when exposed to the steam heat for any length of time. The non-conducting covering is formed by a layer of infusorial earth ⅓ in. thick, covered by 1⅛ in. of paper pulp; next follows a cover of jute canvas lapped with galvanised iron wire, with a double coating of sheet iron and lead, painted with asbestos paint outside. Drain cocks are placed on the steam pipe at four different points between the boilers and the engines, three of them being automatic with floats, while the last discharges into the cistern of the force pumps. The amount of condensation has been determined by experiment to be 0.914 litre per square metere (0·0187 gallon per square foot), of the external surface of the pipe.

In designing the works provision was made for two similar engines to be placed in separate rooms, but having their steam and discharge pipes in common, but at first only one engine was ordered. About fifteen months were required from the first breaking of the ground until the first engine was set to work. The results obtained from trials continued for three months and a-half showed that the work developed in the engine was 348½-horse power, and that of the pumps 287.55-horse power, or a useful effect of 82½ per cent. The actual discharge of the pump is 98·7 per cent. of the theoretical quantity. The consumption of steam under these conditions is 3,531 kilogs. per hour, of which amount 790 kilogs. was condensed and removed by the drain cocks, which reduces the actual amount doing work in the engines. It appears, therefore, that in spite of the great care taken in protecting the steam pipe by non-conducting coverings, the loss by condensation is very considerable, being 22·4 per cent. of the whole steam supply. This, however, is likely to be considerably reduced when the second engine is set to work.

The cost of the two engines and the necessary underground works is given as follows:—

	£	s.	d.
Cost of engines, rising mains and steam pipes.	12,000	0	0
Buildings and preparatory works underground..	5,779	15	0
Total	17,779	15	0

Each engine when making 40 revolutions per minute lifts 960 tons of water in the shift of eight hours, at a total cost—

	£	s.	d.
For steam	1	14	0
Wages	0	6	8
Lubrication	0	3	3
Lighting and current repairs	0	7	1
Total	2	11	0

for 960 tons of water lifted 1,968 ft.—*Foreign Abstracts of the Institution of Civil Engineers.*

A New Diamond Drill.—There has been patented by Theodor Lange a method of setting diamonds in the crown of a drill, which, according to the *Chemiker und technicker Zeitung*, has shown itself to be remarkably durable. The crown was employed in a coal mine for boring a hole 377 feet deep, and remained at the end in a condition which would permit of further use. The diamonds were firm in their setting and the crown had done equal work around its periphery. The diamond drills arranged according to former methods have, as a rule, lasted only a short time, and it follows that this fastening for the Brazils is at least fully as good as others. It has also the advantage of superior cheapness.

Electric Coal-Cutting at Glenclelland Colliery.*

By George A. Mitchell.

The writer resolved a few years ago to make the experiment of applying electricity to the working of coal-cutting machines at Glenclelland colliery. This resolution was taken after careful examination by the writer and Mr. Thomas Dewar, manager of the colliery, of the different compressed-air machines working in Scotland, and with some hesitation, on account of the fact that for coal-cutting, electricity, so far, at least as generally known, had never been successfully employed in this country. There was only one previous attempt for such an application of electrity made in Scotland—that by the late Mr. Durie at Elphingstone colliery. The machine was not successful, but its non-success was possibly due to the unsuitable nature of the seam to which it was applied. Some machines had been introduced in England, such as the Goden bar-cutter machine, but, as far as could be ascertained, they were still in the experimental stage, and little information could be obtained concerning them.

There seemed no good reason, however, why the application of electricity to coal-cutting should not be as successful as its applications to haulage and pumping, for which purposes its use was rapidly extending, and the advantages of electrity over compressed-air for the transmission of the power required, if successfully applied, seemed undoubted.

As the experiment seemed worth making, after corresponding on the subject with various electrical firms, an arrangement was made with Messrs. Ernest Scott & Mountain, of Newcastle, to make a machine to the writer's instructions. They agreed to share the risk attached to the experiment, and in the construction of the machinery they spared no trouble to make everything as it should be.

The plant has been in operation for about nine months.

The writer thinks that it will be of interest to the members, in describing the machinery, to give at the same time some notes regarding the various points considered in its construction, and also some of the results of the experience in its working.

On the Surface.—The dynamo is of the improved type known as the Tyne dynamo, it is shunt-wound and constructed to give an output of 166 ampères at an electro-motive force of 300 volts, when running at a speed of 750 revolutions per minute. It is complete with sliding bed-plate, tightening screws, brackets, etc. This dynamo is to be converted into a compound-wound machine, as this is considered more suitable for the permanent arrangement.

What is necessary in an installation of this kind, where there is considerable variation in the power required, is to have the electro-motive force as nearly as possible constant for the same speed of engine, and independent of the amount of current required. This result is attained fairly well by the use of a shunt-wound dynamo when it is working well within its capacity, but when it is overloaded the electro-motive force rapidly falls, and, if the load be maintained, there is a possibility of the current falling to zero. A compound-wound dynamo may be so made that the electro-motive force is practically constant within the limits of certain current-variations. These variations for different dynamos are shown by their characteristic curves, which are to the dynamo what the indicator-diagram is to the steam engine. A description of these curves may be found in text-books on the subject.

The engine which drives the dynamo is horizontal, with a cylinder 18 inches in diameter and 3½ feet stroke, with scroll expansion-valve, and ball-governor, and works at about 50 revolutions per minute. The steam-pressure at the boilers is 45 pounds per square inch. The engine drives from a turned fly-wheel 11 feet in diameter, and there is a counter-shaft with pulleys to bring the speed of the dynamo up to 750 revolutions per minute. The engine is connected to a counter which indicates the number of revolutions worked for each shift.

The switch-board, besides switches, has a voltmeter and an ampèremeter, and there is also in circuit a recording ampèremeter or ampèreograph, which indicates the variation of the current during each cut.

Cables.—There is at present in use a temporary cable of 19 18 wires, insulated with vulcanized indiarubber and braided, carried down the shaft and along the underground workings, on insulators, to the coal-face, a distance of about 2,200 feet.

The permanent cables, which are yet to be put in position, are (*a*) for the shaft 37 15 cable covered as follows: (1) one coat of pure Para indiarubber, (2) two coats of vulcanizing india rubber, (3) one coat of vulcanizing tape, (4) the whole vulcanized together, (5) braided hemp, (6) armour of galvanized iron wires, and (7) braid and preservative compound. The insulation-resistance is 1,000 megohms per mile, and the cable is of sufficient size to carry without excessive loss the whole current which the dynamo is capable of producing. This cable will be attached at the bottom of the shaft by means of water-tight switches to (*b*) the smaller cables, which will each be large enough to carry the current required for one coal-cutter. These cables have each 7 wires, No. 15 wire gauge, insulated with vulcanized indiarubber (the insulation-resistance being not less than 600 meghoms per statute mile, then armored with one covering of galvanized iron wires, and braided and compounded over all. These cables will be carried on insulators. The size is sufficient to carry 30 ampères without undue loss. (*c*) Flexible concentric cable, insulated with vulcanized indiarubber, and spirally armored outside, will be used at the coal-face.

Coal-cutter.—The first machine supplied, which, as stated, has been working about nine months, had certain slight defects, which are being rectified in the second machine which is not delivered yet (Figs. 1 and 2, Plate VI.) This machine is 7¾ feet in length, 40 inches in breadth, and 23 inches in height. The frame is made of steel, and the total weight is about 32¾ cwts., which is considerably lighter than the first machine which has been in operation. There is a strong sheet-iron covering over the motor, and there are also bands over the toothed wheels to prevent breakage by falls from roof. The motor is series-wound, which seems to be as good as any form for the purpose. The only disadvantage in this form of motor is that the speed becomes rather high where there is no load, the revolutions increasing, as tested, to 1,300 per minute. A shunt-wound motor would give a more constant speed, but it has not the same power for starting, although there are devices for overcoming this difficulty.

The speed for which the motor is designed is 600 to 700 revolutions per minute, and it gives 12 effective brake horse-power, although it will work up to a greater power if necessary.

The cutter (Fig. 2) is of the disc type, and is intended to combine the advantages of two well-known machines, which are worked in Scotland by compressed air—the Rigg and Meiklejohn, and the Gillott and Copley machines. These machines differ from each other in several important particulars. The Rigg machine has a disc which works on the level of the pavement at the comparatively high speed of 60 or 70 or more revolutions per minute, and which has generally only about six cutters in the circumference. The picks enter the cut in the front and turn towards the back of the cut. The Gillott machine has a disc which cuts above the rail-level; the disc works at the slow speed of about 15 revolutions per minute, and it has about 20 cutters in the circumference. The disc turns from the back of the cut to the front, the aim

* Proceedings Mining Institute of Scotland.

Fig. 1.

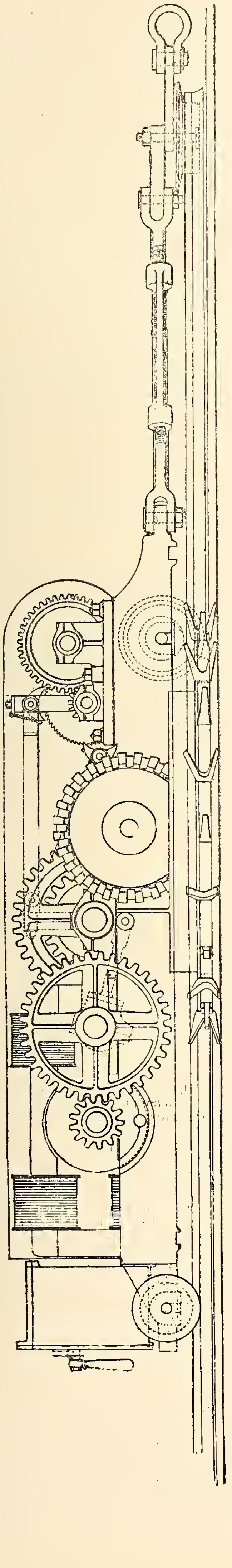
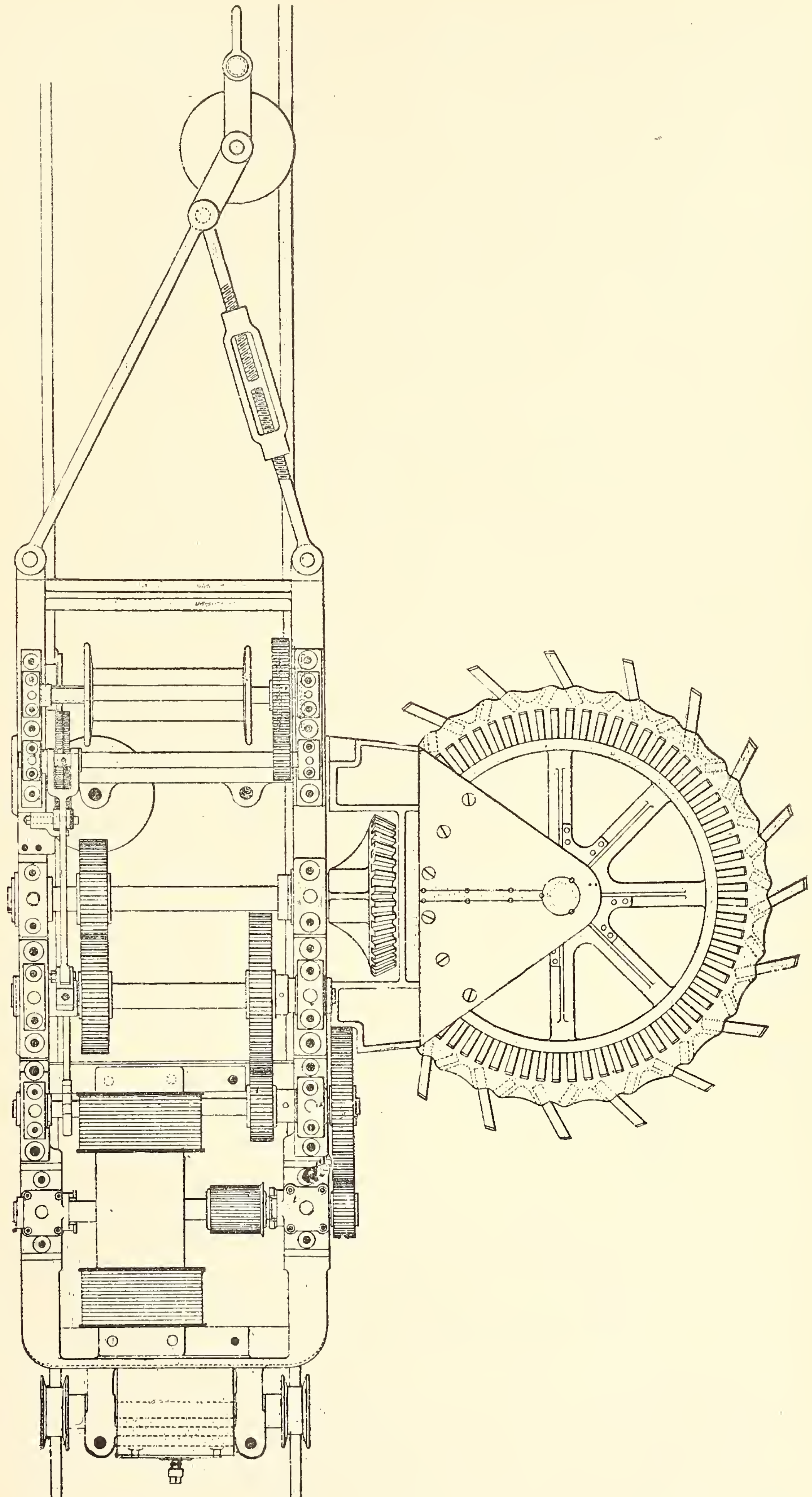


Fig. 2.



apparently being to draw the machine into the coal-face rather than thrust it out from it. In working this machine is slightly tilted up by raising the sleepers at the outside, and the disc slopes from a few inches above the pavement in front of the cut to the pavement at the back. The disadvantage of this arrangement is that if the pavement below the holing be hard, the picks are apt to be blunted by striking against it at the back of the cut, and if there be a coal-holing there is some waste of coal in the front, or if there be a fireclay holing there is the necessity of cleaning the fireclay from the coal at the back of the cut. The advantage is that the disc clears itself better of the cuttings than in the Rigg machine, as there is no obstruction to prevent these from going between the rails. The width of the machine can also be made rather less, as in the Rigg machine some extra width is required to allow room for the extra projection of the bevel-wheel, which gears into the rack on the disc. The question of the width is one of very great importance where the tendency of the roof is to be soft.

The general effect of the higher speed of the Rigg machine seems, in practice, to be to make it more suitable for a coal-holing, and the Gillott cutter, on the other hand, is generally more successful where the holing is fireclay or daugh. The direction of the motion of the disc seems to matter little in practice.

The holing of the virtuewell coal-seam at Glenclelland colliery, for which the cutter was designed, is daugh and fireclay, varying in thickness, but generally easily cut. As thought most suitable for this holing, the disc of the machine was designed to run at a comparatively slow speed—about 25 revolutions per minute—and there are 20 picks on the circumference, fixed somewhat similarly to those in the Gillott machine. The disc, on the other hand, is supported in its place similarly to the Rigg machine, and cuts level with the pavement. The cut is 3 feet in depth and about 3½ inches in height. It will be seen from Figs. 1 and 2, Plate VI., that the speed of the motor is reduced by gearing, there being in all four shafts, including the armature-shaft of the motor. The disc is turned by means of a bevel-wheel, which gears into a rack on the disc inside the circumference.

For oiling the bearing of the disc, there is a large cup in the cast-iron bracket supporting the disc; this cup is covered by a sheet-iron lid (which is screwed on), and is filled once in each shift with waste soaked in oil. The brass under the bracket near the frame, which keeps the disc horizontal, cannot in practice be lubricated at all.

The machine is drawn forward by means of a flexible wire rope, which passes round a drum in the framework of the machine, round a pulley fixed to a prop some distance in front, and back to the machine, where it is fixed to the frame. The drum is turned by means of an eccentric on one of the shafts, which gives a reciprocating motion to a pawl; this catches the teeth of a ratchet wheel, keyed on a shaft which is geared to the shaft whereon the drum is fixed. By means of a slot, the feed may be varied, the pawl taking one to three teeth for each motion as desired.

On the first machine, there was a friction-arrangement in connection with the drum, so that it might slip with any extra strain, but there was considerable trouble with slipping when slipping was not wanted, and the arrangement was abandoned.

The switch for reversing the motor has two sets of resistances and three steps, so that the current may be gradually turned off or on. There is also a small auxiliary rapid cut-off switch, which has been found convenient for use throughout the shift, and which is cheap and easily repaired.

Working of the Cutter.—Four men are required to work the machine. One man attends to the swith, etc., and sees that the disc is cutting rightly; he also hands the rails and sleepers over the machine, and puts up gibs along with another man who also shovels out the cuttings. The other two men lay the rails and put up timber.

A great part of the work consists in handling the rails, and on the expedition with which this is done greatly depends the length of wall that can be cut.

The machine has regularly cut 420 feet in length, 3 feet deep, in a shift of 10 hours. When cutting in the ordinary holing it easily cuts 3 feet in 1½ minutes, and can do so continuously when it is kept in rails. From the diagrams of the ampèreograph it can be seen that there are considerable stoppages. This instrument was not put into circuit until the length of wall was reduced, owing to a number of places being marched, but the following are examples of what is shown for a cut of 210 feet:

	7th March.	9th March.
Machine working.	10 minutes	25 minutes
" standing..	15 "	10 "
" working..	10 "	33 "
" standing.	18 "	15 "
" working..	15 "	20 "
" standing..	3 "	5 "
" working..	20 "	30 "
" standing..	10 "	5 "
" working..	40 "	13 "
" standing..	10 "	40 "
" working..	30 "	70 "
" standing..	25 "	8 "
" working..	45 "	5 "
" standing..	10 "	
" working..	20 "	Total 279 "
Total.	281 "	

Sixty to seventy minutes at a time is about the longest interval during which the machine has been shown by the ampèreograph to have been in continuous operation. Owing to the sensitiveness of the ampèreograph, there is too much vibration in the movement of the pen for the markings to be reproduced satisfactorily.

The experience in working the machine has called attention to certain practical points, some of which may be noted here:—

As has been stated, the weight of the second coal-cutter is about 32 cwts., and of the one which has been working somewhat more, considerably heavier in both cases than any of the machines worked by compressed-air. The extra weight is an advantage in giving steadiness while the cut is being made. There is less vibration than with compressed-air machines, partly on account of this extra weight, and partly because there is no reciprocating motion.

The extra weight, on the other hand, has several disadvantages. Heavier rails are required, which require more labor for shifting and laying. When anything goes wrong, the machine is awkward to handle, and there is additional expense in shifting into the new cut at the beginning of each shift. The first machine supplied takes about one to one and a half hours of three men to bring it forward to its new position, and this adds something like one-ninth to the cost of cutting each wall. There is an arrangement in the new machine, however, which it is expected will save much of this time. It will be seen from Fig. 1 that there are notches in each end of the frame, for the insertion of rails on which the machine should be easily moved. As these rails must be clear of the picks on the disc, and sufficiently far from the cross-bars on the ends of the frame to leave room for a lifting screw to work, the framework is, of necessity, made rather longer than otherwise necessary. This is some disadvantage.

Some difficulty was found at first, when the disc got jammed in the cut, in getting the machine clear. In such circumstances, the pawl being caught firmly in the ratchet-wheel, any motion of the motor increased the difficulty, and the motor could not be reversed without some loss of time. In order to get over this, there is a swivel with screw-attachment for the pulley, round which the drawing-rope turns. By turning this swivel and screw the rope may be slackened, to enable the machine to be moved a few inches out of the cut and the disc to be relieved.

To keep the rails firmly in position, and to resist the extra strains which at times tend to thrust the machine from the face, every second or third sleeper has projecting from the end farthest from the face, a piece of iron turned into a horse-shoe shape, into which a prop may be inserted, and fixed firmly between the roof and the pavement.

The wall at first in operation was at an inclination of about 1 in 8, and in coming down the machine required to be held back. At first this was done by means of a wire rope and drum, but it was found better to use a goose-arrangement to run on the rails in place of the ordinary wheels. This goose is made of malleable iron, and is all in one piece, the two ends being joined together by a bar which has two holes, into which are slipped two pins, which pass through holes at the end of the framework of the machine. The arrangement works satisfactorily.

Tests.—The writer regrets that the tests which he is able to submit are not so satisfactory as could be wished. When the testing instruments were available, the length of the wall was only about 210 feet, and on the occasion when the tests were made, the butterfly-valve, working in connection with the governor of the engine, was out of order. Every care was taken to keep the voltage as steady as possible, by carefully watching the voltmeter and regulating the speed by hand, but errors may have crept in where simultaneous readings were necessary above and below ground. The figures are, however, given as recorded, and further tests may be made before the next meeting.

TABLE I.—EXPERIMENTS.

—	Revolutions per Minute.	Indicated Horse-power.	Volts.	Ampères.	Electric Horse-power.
Engine running light............	50	4·1	—	—	—
Engine with dynamo and switches	50	10·5	—	—	—
Engine with full load..........	50	14·2	—	—	—
Dynamo.....	750	—	300	—	—
Motor and cutter..............	800	—	275	15	5·5
Loss in cables..................	—	—	25	—	0·5
Loss in shunt of dynamo.........	—	—	—	2	0·8
Loss in leakage.................	—	—	—	5	2·0

It is readily seen from Table I. that the plant is not working to full advantage. The engine is large enough for five or six times the work that is being done, the dynamo shows a greater percentage of loss than would be the case if it were working with a heavier load, and the efficiency would be very much greater if there were more cutters at work. The resistance of the shunt of the dynamo is 180 ohms, and the current that is passing through it is about 2 ampères. This is in addition to the amount of current shown by the ampèremeter. There appears to be a leak somewhere of about 5 ampères (from the indications of the ampèreograph), and it is probably due to the cables in the shaft being only temporary and not sufficiently insulated. The motor is not using nearly as much power as was expected.

Results of Working.—In connection with an installation of this kind, probably the first question that will be asked is, what is the advantage of the use of machinery in place of hand labor? The writer regrets that he is unable to give a very decided answer. The machine has hitherto not been working to the best advantage for various reasons.

The section of the virtuewell coal-seam at Glenclelland colliery, taken from one of the machine walls, is as follows:—

	Ft.	Ins.	Ft.	Ins.
Roof—				
Roughband ironstone........................			0	8
Fakey blaes..................................			1	6
Brushing—				
Fakes..			3	6
Working—				
Black shaley blaes....................	0	5		
Good gas shale........................	0	4		
Shale and blaes.......................	0	9		
Virtuewell coal........................	2	6		
Daugh holing...........................	0	3		
			4	3
Hard pavement—				

The coal itself has a bad parting from the roof, and it has been found best to take the working to the height shown, the 14 inches of shaley blaes being turned over into the stowing, after the 4 inches of good shale has been picked out to be sent to the surface. The coal has to be blasted.

Owing to the extra thickness of brushing at this portion of the field, the walls were driven 60 feet in length, instead of 45 feet as usual in other parts of the seam, to save expense. It was thought that two men might be able to fill the coal from 60 feet, but this was found on trial to be too large a quantity, and in consequence it was found practically impossible for the machine to work every shift. More than two men could not work at each wall, owing to the large turnover of rubbish. This irregularity added to the expense of working. One reason why the filling was more difficult to manage than anticipated was that the blaes fell over in large pieces, which were difficult to handle. When the coal is worked by hand the holing is not so deep, and the pieces of blaes are smaller and more easily dealt with.

It is expected when the machine is in full operation in the new wall, which is in a direction at right-angles to the old one and level, that less blasting will be required to bring down the coal, and that the cost of filling will be considerably reduced.

Meantime the comparison between the cost of working by hand and by machine may be taken as follows:—

	Per Ton. s.	d.
Cutting and filling by hand .... 1s. 8d. to	1	10
Cutting by machine, including cutting-out at each end of the wall..........	0	3·5
Filling, which has varied from 1s. 1d. to 1s. 3d. per ton..	1	3·0
Fuel (estimated)............	0	0·5
Upkeep and attendance on surface, sharpening picks, etc..	0	1·5
Interest and depreciation	0	1·5
Total.................	1	10

This statement shows no saving, but there are other points which must be considered besides the actual cost per ton at the face. There is less dross and larger coal produced from the machine walls. There is a much larger output from the same faces, and therefore a less cost of upkeep for roads. There being a greater concentration of output, the haulage can be more economically managed. On the other hand, the wall advances so quickly that the driving of slope-roads will be more costly than in ordinary circumstances, as they must be made more expeditiously than is usually the case.

Various savings can be made in the items named when there are more cutters at work, and the writer anticipates that while there may not be a great saving over hand-labor at Glenclelland colliery, yet there will be some clear advantage in the use of machines. It seems to be very much, as often stated, that the use of machines is only advantageous if the circumstances are favorable, and that there is no great saving in ordinary cases when wages are low. The essentials are a clean field and a strong roof, and the harder the holing the greater will be the saving. As regards the use of electricity instead of compressed-air, there seems little doubt that the former method of transmitting power must supersede the latter, except possibly where there is fire-damp present, or where the workings are wet. There is some danger from the sparking of the brushes in an explosive mixture, though this difficulty will no doubt be got rid of in the future. Meantime caution must be exercised. With water falling it might be difficult to keep the resistance of the armature right, and any colliery owners who have wet workings should consider this defect before adopting electricity.

The only advantages of electricity that need be named here are the greater efficiency, the convenience of erecting wires instead of laying heavy pipes, and the facility with which the results of cutting may be observed. There is also the feature that the power given out by the dynamo is in proportion to the power required at the motor, and may rise, temporarily, without damage, much above the average, when for any reason extra power is required.

From experience of the machinery, breakdowns are no more likely to occur with electric than with compressed-air machines, and the parts that require renewal and repair are the parts which are the same in machines driven by either power.

There is very little difference in the first cost between plants worked by compressed air and by electricity. The cost of upkeep should be much the same. For very thin seams lighter machines should be made. This can be done by giving the motor a higher speed, and by working with less power. It is by no means clear that a lighter machine cutting more slowly will not cut nearly as much as the heavier machine, as it might be possible to keep it cutting more regularly with fewer stoppages. An important point about all machines is the regularity of feed, jerks should be avoided, and the aim should be to keep the cutter travelling forward as steadily as possible.

Modified System of Longwall Working.

At the last meeting of the North Staffordshire (England) Institute of Mining and Mechanical Engineers, held on April 8, Mr. John Heath read a paper in which was described a modified form of longwall workings as applied to thin seams of moderate inclination. He observed that the system of working to be described, though perhaps not new, had so far not been previously applied in that district. In a district like North Staffordshire the economical working of thin seams must always be one of the difficulties that confront a colliery manager, and a description of any method that tended to reduce the cost of getting coal would be valuable. In a thin seam the dead work was always necessarily costly, and it was by seeking to reduce the amount of ripping that attention was directed to what he might call the "Spunney system." As an example of practical feasibility he might cite the two foot coal seam at Sneyd colliery. In this seam, with an average thickness of 2 feet 1 inch, there was room to pack all the dirt from roads 6 feet by 10 feet used for levels, 5 feet by 7 feet used for spunneys, and from the main jigs where the ripping was 3½ feet thick. The hard ripping dirt was used for building the walls at the sides of the roads, no stone whatever being sent to bank. Where the coal seam had thinned down to 12 inches they were able to work it, although, of course, in an extreme case like this, the working cost almost prohibited its competing against coal produced from seams varying from 3 feet to 8 feet in thickness. The main object of the system was to enable the coal to be loaded into the waggon without taking it along the face, and to accomplish this object the jigs or spunneys were placed at a distance of only 42 feet apart from centre to centre. The loader reached the coal as far as possible, and in the remaining 5 or 10 feet the coal was turned back by the coal getter, as was the usual custom in other methods of working. The waggon was not unhooked from the chain, the front wheels being simply dropped over the end of the rails and the two brake wheels screwed up. In the case of the two-feet coal seam it was thus possible to load a waggon standing 33 inches high on the rails, and holding 10 to 12 cwts. of coal, at the face of a seam measuring only from 23 inches to 25 inches in thickness. The spunneys were arranged in pairs, with a single line of rails in each, the empty waggon travelling first in one and then the other of the pair, the chain passing along the face between the road ends. They were driven in this form for a distance of 240 feet, then a top level was formed, and one of the spunneys used as a standing jig. These jigs were laid with a single road at the top and bottom, so that the spunneys need not be made of extra width except at the pass-by. One stand jig would, as a general rule, serve for five or six pairs of spunneys, the tubs being jigged in runs of two or three, as the several lengths of stand jigs were connected up. In breasting out the levels, a solid pack of at least 36 feet wide was placed on the deep side, and one of 30 feet wide on the head side. Pack walls were built at right angles to the level at intervals of five feet, and the loose dirt between rammed solid up to the roof. When the pinnings were built diagonally, as was often the case when the deep side of the breasting was pushed in advance of the head side and the pack walls formed an acute angle with the level, they were found to push out much more readily than when square up. Chocks were built in at the head-side at the corners of each spunney, and on the deep-side midway between the two spunneys, so as to come alternately on either side of the road. More stress has been laid upon the question of packing than would perhaps be thought necessary, but proper packing, in the first instance, was of the utmost importance, and could not be emphasized too strongly, for not only was it essential in keeping a good level, but it prevented air leaking through into the wastes, with its accompanying evil—gob fires. In the discussion which followed, Mr. E. B. Wain, the president, thought this plan, showing a method of working a coal so thin as 2 feet, was particularly interesting. The time had not yet come when they had to work a very large quantity of coal so thin, but they did not know how soon they might have to do so; and it would be well to consider the best method of doing it. The system adopted at Sneyd colliery appeared to be somewhat similar to that adopted in the best collieries in the great Midland district, where it was the practice to make gate roads and cut them off with cross roads at such intervals as were necessary in accordance with the nature of the roof. Mr. Heath had not indicated the nature of the roof being worked by this system, but it struck him (the president) that if in a system like that they had a hard roof to contend with they would be put to serious expense in yard work and ripping. That was an idea perhaps based on imperfect knowledge of the system as worked at Sneyd colliery. He had an opportunity two or three years ago of seeing the system at work, and thought it seemed a practicable method of getting thin seams. It appeared, however to him rather a misnomer to call this kind of working longwall. His idea of longwall was continuous face of work, and in this case, where there was only a total length of continuous face of 26 yards, it could scarcely be called longwall. Mr. Heath said the roof in the seam he had been working on the principle described was good hard level.

Note on Sampling Iron Ore.*

By E. K. Landis, Pottstown, Pa

In connection with the interesting paper of Mr. Glenn on "Sampling Ores without use of Machinery," read at the Cleveland meeting, I venture to offer the results of ten years' experience in the sampling of iron ore by a method adopted when I first beecame engaged in the analysis of ores, and continued to the present time. This method seems simpler than the one described in Mr. Glenn's paper, and it has proved for iron ore, quite accurate, as checked by samples taken according to more elaborate methods, and analysed by such chemists as McCreath, Booth, Garrett Blair, and others, with results rarely differing more than 0.1 to 0.2 per cent. I regard it, therefore, as not less satisfactory, while it is much more rapid than other methods.

If a pile or car load of lump iron ore is to be sampled, each piece that can be reached over the entire surface is picked up, and a small fragment is broken off and kept, the size of this fragment being governed by the size of the lump from which it is broken, that is, a larger piece being taken from a large lump than from a small one. In case the lump consists of ore with adhering gangue, a piece of each is taken, the size depending, as before, upon the size of the lump and the relative amounts of gangue and ore in it.

When the entire surface has been gone over, the sample is reduced by crushing until it all passes a 10-mesh sieve. It is then thoroughly mixed on a large sheet of hardware paper, first with a coal shovel, then by turning over and over from end to end, and from side to side. When thoroughly mixed, a small portion is taken with a large spatula from points all over the heap, and this is reduced in a Riotte mortar until it all passes a 20-mesh sieve. It is then again treated on the paper as before, and the resulting sample is passed through a 40-mesh sieve and bottled. This is subsequently mixed once more on a smaller paper, and a sufficient quantity for analysis is taken out and ground to the required fineness in an agate mortar.

The above procedure is employed, as already observed, for lots consisting entirely of lump ore. When fine ore mixed with lump is to be sampled, the lump is sampled first as above; then the fine is sampled by taking pinches or handfuls from all over the exposed surface, the quantity taken being such that the same ratio is observed between fine and lump in the sample as exists in the ore itself.

While the element of judgment involved in this method creates an undoubted source of possible error, and makes such error easy through ignorance, carelessness or intentional dishonesty, the practical question is, whether the method, intelligently used on such material as iron ore, actually gives trustworthy results. An excellent test of this question is afforded by the sampling and analysis of crude ore, concentrates and tails carried on for four months at the Tilly Foster mine. The crude ore was sampled as above described. Of the concentrates, cores were taken in eighteen different places on each carload by driving through it a 1½ inch tube, slightly swedged in at the lower end, like a "choke-bore" gun. The tails were sampled by collecting four bucketfuls from each spout, allowing them to settle, decanting the water, and drying the residue.

The weights of crude ore and concentrates were accurately known, and it is evident that by applying to the results of the analyses of the samples the formula given by Mr. Birkinbine (*Trans.*, xix., 673), a figure representing the number of tons of crude ore required to produce one ton of concentrates could be obtained, which, if, sampling and analysis were correct, would correspond with the direct determination in practice. In the discussion of Mr. Glenn's paper, already cited, Dr. Raymond has applied this test to reports of concentrating experiments, arguing from the discrepancy between the results of the formula and the reported weights actually used and produced, that there must have been defective sampling for analysis.

Such a comparison was made for the operations of four months at the Tilly Foster mine, with the following results :—

	1	2	3	4
Factor directly found from weights......	2.52	2.360	2.73	2.760
Factor calculated from analyses.........	2.43	2.292	2.66	2.626
	0.09	0.68	0.07	0.134

This agreement is as close as could be expected ; and the almost uniform difference in one direction points rather to loss of material in handling than to defects in sampling or analysis. The latter might be expected to give variations in either direction.

*Transactions of the American Institute of Mining Engineers.

Water-Tube Boilers.

By Allan Stirling.*

Previous to the year 1880, water-tube boilers were very little used, but since that time their use has been gradually extending, until at the present time there are probably more boilers of that type built than on the fire-tube system. There were several reasons for this change from fire-tube to water-tube boilers, but chiefly because a properly designed water-tube boiler is the most safe, economical, efficient and durable.

The first meeting of the American Society of Mechanical Engineers was held in 1880, and the writer contributed a paper on the subject of "Practical Methods for the Economy of Steam." The use of higher pressures was strongly advocated in that paper as one of the elements of economy. Pressures as high as 300 pounds per square inch were suggested, and a statement made as to the economy of using steam at that pressure as compared with steam at the then common pressure of 75 pounds per square inch.

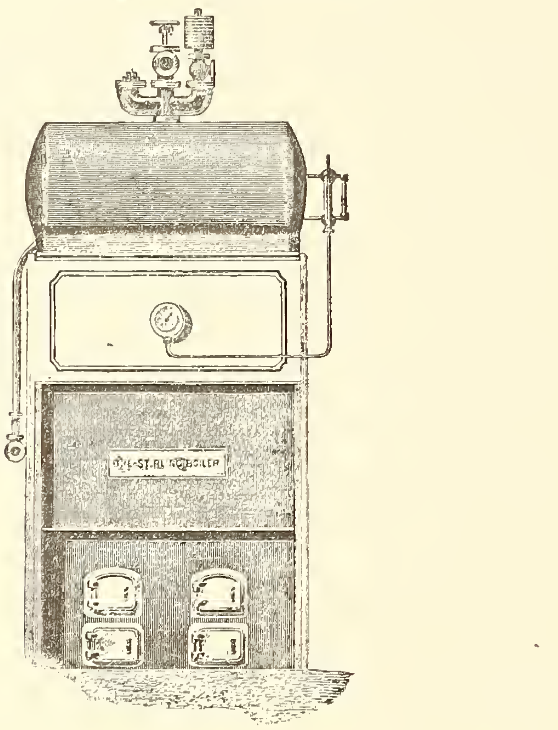
In considering the question of the most efficient boiler at that time, the water-tube system was not even mentioned by the writer, and drawings were given of a special construction of a fire-tube boiler suitable for the production of high-pressure steam.

* Proceedings Mining Institute of Scotland.

In the year 1885, the writer read another paper before the same society on the subject of "Shell and Water-tube Boilers," showing that the water-tube system had made headway during the interval between the two papers being written. In preparing the latter paper, occasion was taken to go into the relative merits of the two systems, and the writer became convinced that the water-tube system had great advantages over the older type. The only types of water-tube boiler at that time in the market were the Babcock and Wilcox, the Root, the Heinie, etc. ; these types consist of a series of tubes slightly inclined from the horizontal, expanded at both ends into headers, and connected to the steam-and-water reservoir above and to a mud-drum below.

In 1886, the writer constructed a water-tube boiler, which was worked at a pressure of 200 pounds per square inch. It was composed entirely of Field tubes, screwed into the bottom plate of a rectangular steam-and-water receiver. This boiler was worked for a short time, but the sediment gradually accumulated at the lower end of the tubes, and the boiler was ultimately thrown upon the scrap heap.

In 1887, another boiler similar to the former was built, with the addition of a mud-drum, to which two rows of tubes were connected, the idea being that the circulation of the water produced by means of the tubes through the mud-drum would prevent the sediment from collecting in the bottom ends of the Field tubes. This arrangement proved to be only partially successful, but this boiler is still doing good work.



The writer then decided to discard the Field tubes, and used two cylinders connected by tubes instead of the rectangular upper vessel. The two upper drums were connected with the lower or mud-drum by two series of tubes divided by a fire-brick baffle-wall, the flame going up the front set and down the back set of tubes to the chimney-flue. This boiler proved superior to the others, but the feed-water had either to be delivered into the mud-drum (thus constantly stirring up the mud), or else into one of the upper drums where the heat was so great that the deposit from the feed-water would be baked into a hard scale.

The remedy for this defect was found in the present form of the Stirling boiler, in which the water-tubes are expanded directly into the drums (Figs. 1 and 2). There are no flat surfaces, no stays, and no headers, with their numerous hand-holes.

The Stirling boiler is practically self-cleaning, because the water is fed into the back upper-drum, and descends with a slow motion of 6 inches per minute to the mud-drum through the back group of tubes, which have an area 100 times greater than that of the feed-pipe. On entering the mud-drum the feed-water has reached the boiling-point corresponding to the pressure under which the boiler is working. The scale-forming matter, together with other solid matter held in suspension prior to the feed-water entering the boiler, is deposited on the bottom of the mud-drum from which it is readily blown off. This arrangement ensures the supply of practically pure water to the front and middle groups of tubes, where the steam is made.

The horizontal fire-tube has deposits of coal-dust and fine ashes on the inside and of sediment on the outside ; the common water-tube has deposits of sediment inside and coal-dust outside ; and the Stirling water-tube has comparatively clean inside and outside surfaces. The Stirling boilers are giving the highest possible results that are opened only once in six months, and even then very little cleaning is necessary.

With regard to utilization of heat : the heat of the fire-gases is thoroughly exhausted before they leave the water-tube boiler, because (1) the fire-gases are caused to pass successively over the whole length of the three groups of tubes ; (2) the water and fire-gases are divided into small sections by the tubes ; (3) the form of the current of fire-gases is changed nine times in passing from the furnace to the chimney ; (4) the heating surface is comparatively clean, both inside and outside ; (5) the heating surface is thin ; and (6) the gases leave the boiler where the feed-water enters, thus reducing the temperature of the escaping-gases and heating the feed-water with the waste heat. This renders it possible to reduce the temperature of the escaping-gases below the temperature of the steam.

The circulation of the water in the boiler is steady and thorough. Each tube has a separate outlet to the drums of the full size of the tube. Steam is made in the front and middle groups of tubes, and these tubes are inclined at the best angle for allowing the steam to pass freely and quietly to the steam-space without carrying water with it. The geyser-like action which takes place when water is boiled in a vertical tube entirely disappears when the tube is sufficiently inclined and working under pressure. The circulation of water between the front and middle drums passes freely through the numerous tubes which connect them below the water-level.

The tubes are divided into three groups, each of which is expanded into a separate drum. This arrangement allows for unequal expansion and contraction in each group, and the bends in the tubes provide for any unequal expansion in the individual tubes.

By opening four man-holes, one in each drum, access is gained to the inside of every part of the steel-plates and to the ends and the interior of every water-tube. Openings are provided in the brickwork for the purpose of getting at the outside of the plates and water-tubes.

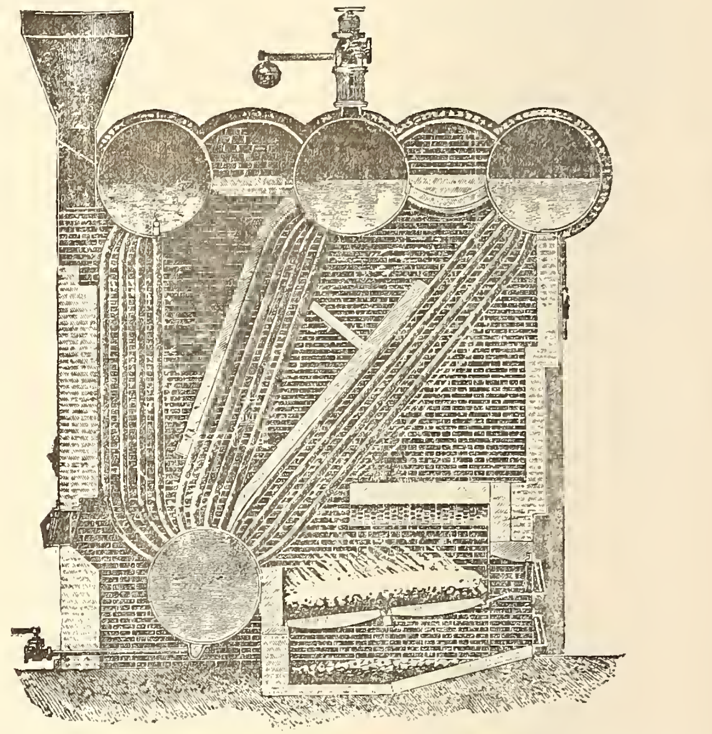
The quiet and thorough circulation of water, the large area of water-level, and the large capacity for steam and water, ensure a steady supply of dry steam.

The advantages of using high-pressure steam are widely recognized, and its use in modern engines is increasing rapidly. The merits of the water-tube as compared with other boilers for carrying high pressures, are conceded by the best engineering authorities ; and the Stirling water-tube boiler commends itself because (1) there are no riveted joints exposed to the heat ; (2) there are no flat surfaces, and, consequently, no stays are required ; the outside surfaces of the tubes are the only parts with which flame comes into contact ; (4) the ends of the tubes are in water ; (5) there is no heating-surface above the water-line; (6) all the parts are of wrought steel ; (7) the tube-plates are made thicker to allow for drilling the tube-holes ; (8) expansion and contraction have been thoroughly provided for ; (9) the water is divided into small sections ; (10) the circulation is steady and thorough ; (11) it is practically self-cleaning, so that the boiler seldom requires to be opened ; and (12) there are only four joints to break to get access to every part of the boiler.

The numerous divisions of the water and fire-gases and the thin tube heating-surface, combined with the free circulation, ensure rapid and efficient steam-raising.

If from carelessness there should be a heavy fire in the furnace and the water left low, the worst that could happen would be rupture of one or more of the water-tubes, and the pressure would be relieved without serious consequences. Should such an accident occur to the tubes, others can readily be substituted without injuring any good tubes. The tubes are very easily removed and replaced, because they do not require to pass their whole length through the tube-hole as in other boilers, but only about an inch through the hole and back again, and they are clear. The tubes connecting the drums are readily fixed with the usual expanding tool.

Owing to its construction, the water-tube boiler will admit of a wide grate-surface, giving to each section its full quota of heat, and enabling the fireman to work the fire properly, which cannot be the case where the grate-surface is obtained by a long narrow fire-box.



There is a large draught-area resulting from the wide grate-surface and large tube-chambers. The nearly vertical position of the tubes and the arrangement of the brick baffle-plates in the tube-chambers ensure a good draught.

The combustion is good because (1) the air supply to the grate is heated ; (2) the oxygen and carbon are thoroughly mixed and heated to a high temperature on the large furnace ; and (3) the combustion is completed in the combustion chamber before the fire-gases reach the tubes. Radiation through the brick-setting is prevented by the erection of double walls with an air-space between. The air is drawn in through this air-space to the ash-pit, and the heat that would otherwise be lost by radiation is carried back into the boiler and utilized for heating the air for combustion.

The advantage of a thin heating-surface over thick plates is apparent. The thin clean tube-surface in a water-tube boiler cannot be injured by the most intense fire, so long as the tubes are full of water.

The Stirling water-tube boiler occupies less space than any other boiler, and the fire-room can be made any width without regard to the taking out of the tubes. The small space required for boilers and fire-room effects a saving in cost of ground, foundations, and buildings.

The Stirling water-tube boiler is supported on wrought-iron columns, and is sustained independently of the brickwork. It is free to expand and contract without affecting the brickwork, which may be removed and replaced without disturbing the boiler or connections. The furnaces and grates can be arranged for coal, wood, bagasse, oil or any other fuel.

The following are the principal dimensions of Stirling boilers recently erected :—

Locality.	Kilmarnock.	St. Enoch's Station, Glasgow.	Motherwell.
Heating-surface, square feet	621	2,587	4,370
Grate-surface, do	11	34	90
Ratio of heating to grate-surface.	56	76	48
Number of water-tubes.........	78	264	391
Diameter of water-tubes, inches.	3¼	3¼	3¼
Diameter of drums, feet	3	4	4
Length of drums, do	5	9	11
Floor-space occupied, width, feet	7¼	11¼	14
Do do depth, do.	14	15½	17

Mr. James S. Dixon (Glasgow) wrote that Babcock and Wilcox water-tube boilers had been in use at Hamilton Palace colliery for about a dozen years. For about ten years they raised large supplies of steam, and gave no trouble. During this time they were fed with water from the pit, which contained little or no free acid, and deposited almost no scale. Since then, water containing impurities of both kinds got access from the old workings of an adjoining collery, and the tubes became both pitted and encrusted. In order to obviate this damage, water for the boilers is now being pumped from the river Clyde. The tubes in these boilers lie at an inclination, and the incrustation is chiefly found in the lower 4 or 5 feet of the tubes next to the mud-drum, and may be due to the lower temperature of the furnace-gases at that point, as the circulation through the water-tubes must be the same throughout. Mr. Stirling claimed that the back range of tubes of his boiler being placed in an upright position obviated this difficulty. If this be so, one difficulty with bad water—and a serious one—will have been overcome. Mr. Stirling also claimed that the water-tubes were kept clean, both inside and outside. There is no doubt that an upright tube will not carry dirt outside like a flat or sloping one, and that cleanliness has a marked effect on the steam-raising powers of a water-tube boiler. He (Mr. Dixon) would like to have an explanation as to how the current of fire-gases is changed in direction so many as nine times from the furnace to the chimney. If the steam passes off so quietly as described, priming would be prevented—a most desirable result. The experience of some engineer who had used the Stirling boiler would be valuable on that point. If the case of removing a bad tube was in practice, as described, it was a favorable point, as in the Babcock and Wilcox boilers great trouble was often experienced in withdrawing a bulged tube through the header. There was no doubt that the water-tube form of boiler was a move in the right direction, especially in these days of high pressures; but his experience was that good water was a *sine qua non*. Of course the matter of first cost was a consideration, and it would be desirable to know the cost of the Stirling boiler, say, per 100 indicated horse-power.

Mr. James Frew (Dunaskin) asked whether Mr. Stirling had experienced any difficulty with scale adhering to the water-tubes leading from the back top-drum to the mud-drum, and whether the providing of one hundred times the feed area in the water-tubes leading to the mud-drum entirely overcame the trouble of scale deposit, or only reduced it? In the case of the boiler being fired with coal or dross, when the temperature of the water tubes was lowered during the cleaning of the fires, he thought it probable that leakage at the tube-ends would take place. He asked whether there was any trouble from leakage at that point? It seemed to him, on the whole, that the Stirling boiler was ingenious and well-arranged, and that it would secure the utilization of the heat given off from the fuel.

Mr. R. D. Munro (Glasgow) said that Mr. Stirling need not be surprised if the steam-users of this country were somewhat slow in taking up any type of water-tube boiler. He thought that engineers were justified in being cautious before giving up the Lancashire and other well known types for a design so remote from preconceived ideas of what a boiler should be. It was just possible that they were all wrong in their estimate of Lancashire boilers, but they had before them the fact that they had done nearly all the steam-raising in this country for upwards of thirty years, and that hitherto it had not been proved that boilers of the water-tube type could surpass them in efficiency when working under the same conditions. He also felt certain that the water-tube boiler would never excel the Lancashire in the matter of durability. They had been accustomed to Lancashire boilers carrying considerable pressures for twenty-five years with the greatest safety, and they were naturally anxious to learn how the new types would behave under a lengthened working-test before they took them into their confidence. What Mr. Stirling had said would tend to direct attention to this very important question. The steam-pressures employed were now much above the average of former years, and they were rapidly being raised to a point at which it was perhaps questionable if Lancashire boilers could be worked satisfactorily. When they considered the enormous weight and bulk of a Lancashire boiler, 30 feet in length by 8 feet in diameter, suitable for pressures from 150 to 200 lbs. per square inch, they found themselves face to face with difficulties in transit and greatly increased expenditure for foundations, and it was just probable that the wear and tear, which, with lighter boilers and lower pressures, was very gradual, might be such, under the altered circumstances, as would detract seriously from the usual lifetime of the Lancashire boiler. Whether the water-tube, so-called, or some other form of sectional boiler, would become the type of the future had yet to be determined; but it was evident that some of the leading boiler engineers were of opinion that a sectional boiler could be made which possessed all the advantages of the Lancashire boiler, and at the same time be free from the objections as to great weight, etc., already referred to. In his own experience of water-tube boilers, he had found that they had worked fairly satisfactorily, provided the feed-water was good and the steam requirements were steady, but in paper-mills, dye-works, and other factories where the demands for steam were of an intermittent nature, they had not proved so serviceable as boilers of the Lancashire type. This, he thought, was largely due to the small steam disengaging surface of the water-tube boiler in proportion to its heating-surface. Water-tube boilers were seriously affected by the forced firing that was too frequently resorted to when extra steam was required, the result being that foaming or priming of a violent nature very often occurred, causing great loss of economy, besides endangering the safety of engine cylinders, piping, etc. Great improvements had been effected in the water-tube boiler within recent years, and as they were being adopted by their own and foreign governments for men of war, he thought this was likely to give an impetus to their use on land. The Stirling boiler was a distinct departure from those used in this country, and as it had already attained great success in the United States of America, it was just probable that they might find it had been designed to overcome the troubles incidental to the use of impure feed-water, and priming, which, in certain circumstances, were the serious drawbacks of other water-tube boilers. In the Stirling boiler there was a combined steam-boiler and economizer, the first two banks of tubes forming the boiler proper, and the last bank of tubes forming an economizer, in which the feed-water was heated by gases of low temperature. By this disposition of the tubes be understood Mr. Stirling to say that he could more effectually utilize the heat of the furnace-gases, there being no difficulty in doing so to a degree even below the temperature of the steam generated. The same claims, however, had been made by the various manufacturers of the economizers used in connection with Lancashire boilers, but there was nothing to be gained by reducing the gases to such a low temperature; and, except in cases where there was a very large chimney or some system of artificial draught, it was impossible to work satisfactorily with gases reduced below that of the steam generated. The minimum chimney temperature in good practice was about 400 degrees, but the average, unfortunately was as high as 600 degrees. He had heard of some installations for forced draught, in which the furnace-gases were so thoroughly utilized that they escaped into the chimney at a temperature of about 200 degrees; but, speaking generally, it had been found that, except in special circumstances, there was quite as much economy in maintaining good draught by an expenditure of heat at the base of the chimney, as in providing steam for fans, or jets for artificial draught. The arrangement for feeding the Stirling boiler was an ingenious one, and whilst he would like to see more of it before deciding as to its merits, he was inclined to consider it as being favorable to prevention of trouble in the use of bad feed-water, and thereby likely to promote economy and durability. He understood Mr. Stirling to say that water-tube boilers were now the rule in America, as well as on the continent, and that Britain was alone in her advocacy and continued use of fire-tube boilers. There must, he thought, be some mistake in this, as he was regularly in receipt of reports from an American company, which inspected some 40,000 steam boilers annually, and his impression at the moment was that about nine-tenths of these were of the ordinary fire-tube type. His experience of continental countries went to show that fire-tube boilers still held their own, notwithstanding the numerous patents that had been taken out for water-tube boilers, both in France and Germany. With regard to the large number of explosions in America, compared with British experience, he might state that, according to published statistics, there had been upwards of 300 explosions in the United States of America during the year 1894, many of them being of a most disastrous nature, whilst the average number of actual explosions in this country did not exceed 40 per annum. He thought that these facts pointed to the necessity for improved supervision on the part of American engineers. The boilers, it might be thought, were badly designed or badly constructed, but he was of opinion that the explosions were more the result of the reckless manner in which the boilers were worked and attended to, than to defects in their design and construction. The water-tube boiler was generally spoken of in this country as an American invention, but it might be of interest to Mr. Stirling to know that the late Mr. Rowan, the father of a prominent member of this Institute, if not the first to introduce the water-tube boiler, was at least one of the pioneers. He designed the boilers of the steamship "Propontis," and although these boilers were not successful, they formed a basis or starting-point from which succeeding water-tube boilers were constructed. In conclusion, he would like to know Mr. Stirling's opinion as to the method of discharge adopted in the Thorneycroft boiler. The tubes were arranged so as to deliver through the steam space, and it was said that this added greatly to the efficiency of the boiler. He would also be indebted to Mr. Stirling if he would give some statistics as to the performance of the Stirling boiler. The members were all fairly conversant with the duty and efficiency of the Lancashire and other fire-tube boilers, and it would therefore be very interesting to have full particulars of evaporative tests of the Stirling boiler, so as to enable them to judge of its duty and efficiency. He ventured to express the opinion that good though this boiler might prove to be, it would never surpass the Lancashire boiler in efficiency, but, inasmuch as it was better adapted for carrying very high steam-pressures, and possessed advantages over some other designs of water-tube boilers, it would probably be taken up to some considerable extent by the more enterprising steam users.

Mr. Henry Aitken (Falkirk) agreed with Mr. Stirling that the water-tube boiler was the boiler of the future, but there were circumstances where it would not be so., *e.g.*, where the water was bad. He had had great experience with bad water and scaled boilers and tubes. In connection with one, where Field tubes were used, he had obtained good results, but in the course of a fortnight the whole of the tubes had to be taken out. In doing so he closed the holes with iron plugs, which extended 6 inches into the gas space below, and 6 inches into the water in the boiler, and curiously enough nearly as good results were got as if the Field tubes had been in position. He could not understand how in the Stirling boiler the difficulty of bad water was got rid of. But for all general purposes, where the water was good, he had no doubt, particularly for high pressures, that the tubular boiler was the boiler of the future.

Mr. Stirling said that the current of fire-gases left the furnace in a solid mass, and (1) was divided in strips in passing in among the tubes; (2) it followed the front group of tubes in the form of a rectangle minus the circles of the tubes; (3) it was divided into strips in passing out of the first group of tubes; (4) it passed across the space between the first and second group of tubes in a solid mass; (5) it was divided into strips in passing in among the second group of tubes; (6) it followed the middle group of tubes in the form of a rectangle minus the circles of the tubes; (7) it was divided into strips in passing from the second to the third group of tubes; (8) it followed the third group of tubes in the form of a rectangle minus the circles of the tubes; and (9) it was divided into strips in passing out from the third group of tubes to the chimney. The Stirling cost less than any other boiler, and could be supplied for less than 20s. per indicated horse-power. There was no difficulty with the scale or leaky tubes in the Stirling boiler. He (Mr. Stirling) had found no fault with the cautious feature of the Scotch character, but in these days of keen international competition engineers found it necessary to be very wide-awake in exercising their judgment in adopting the best methods and appliances. The Stirling surpassed the Lancashire boiler when working under the same conditions, and it was much more durable than the Lancashire for modern high-pressures. Although the Lancashire boiler had done nearly all the steam-raising in this country for upwards of thirty years at low pressures, that was no evidence that it would continue to prove satisfactory at the modern high pressures. Mr. Munro questioned whether Lancashire boilers could be worked satisfactorily at high pressures. The Stirling boiler overcame all the difficulties which Mr. Munro had found in Lancashire and in other water-tube boilers: (1) It would work satisfactorily with bad feed-water; (2) the numerous divisions of the water and fire-gases, and the comparatively clean, thin, heating surface, combined with the large steam-disengaging surface, the free circulation, etc., ensured rapid and efficient steam raising, and enabled the Stirling to respond much more promptly to intermittent demands for steam than the Lancashire boiler or other types of water-tube boilers; and (3) the Stirling boiler did not foam or prime. The ordinary way of producing draught by means of heated air in a chimney was wasteful. Years ago, mines were ventilated in this way, but the fan had been universally adopted instead. Fans were used with great economy in connection with steam boilers in many cases. Particularly on shipboard. The most economical way to operate a boiler plant was to reduce the temperature of the chimney gases as much as possible, and to blow the fire with a fan driven by an engine. For large power plants the water tube system was being almost universally adopted in America. With reference to explosions, although there are over twelve hundred Stirling boilers at work in America there had never been an explosion, nor had a single person been hurt by them. He (Mr. Stirling) was familiar with the Rowan boiler that failed on the Propontis, and also with the boiler that failed on the Montana. He considered that it was very objectionable to have any heating surface above the water line. He had not devoted attention to the making of tests, but others had been kind enough to give him their experience. Mr. Eckley B. Coxe, President of the American Society of Mechanical Engineers, on April 6th, 1894, wrote: "We have been running the Stirling boilers at Oneida continuously since May last, and can give no information as to their weak points, as we have as yet found none. We have done nothing to them. We have made many experiments with them, in one case running one of them (150 horse power) up to 240 horse power without any bad results to the boiler. They have not leaked or sprung, and seem as good as when put in."

Mr. Philip D. Armour, of the Armour Canning Co., Chicago, wrote, on April 3rd, 1894: "We have purchased from the Stirling Co. over £23,500 worth of boilers within the past eighteen months, and they have given entire satisfaction. We find them a great saving on coal."

The discussion was then adjourned.

ORES AND METAL MARKET.

Copper—During the past month the speculative market has been subject to somewhat violent fluctuations, under the influence of favorable or unfavorable reports as to the progress of the negotiations to limit European production and American exports of copper, the final conclusion of which is the determination of the Calumet and Hecla Co., of Lake Superior, to decline to be parties to any such agreement, although assented to by all the other mining companies concerned. Various reasons are assigned for this non-concurrence, that publicly announced being that the manager of this company considers any agreement unnecessary in view of the present active demand for copper in the United States due to the very pronounced revival of trade, and that the desired object will be attained without the use of any artificial means. Definite proof of this improved trade is shown in the important advances in wages which are being generally conceded by Producers and Manufacturers, the Calumet and Hecla Company, amongst others, granting an increase of 10 per cent. on the wages of 3,500 men employed by them. This will represent an increase in the cost of the Copper produced by this Company of at least £1 per ton, and follows a similar advance granted a few months ago.

It appears that in the month of April, the Calumet and Hecla Co. sold a large quantity, stated to be 12,500 tons of 2,000 lbs., of their Copper at 9.50 cents per lb. for delivery up to the end of August. The recent, or any further advance, cannot therefore be of much benefit to them for some time to come.

It is stated by those most competent to judge that the exports of American Copper to Europe will probably be less than 55,000 tons for the present year. For the past five months they have been about 24,750 tons, against 30,724 tons for the same period last year, and 77,130 tons for the whole of 1894.

From £41 on the 1st ult., *Good Merchantable Copper* rapidly rose to £45 on the 13th for cash, declining with even greater rapidity to £41 17s. 6d. on the 17th, on realization of profits and reported failure of the agreement negotiations, advancing again to £43 10s. on the 20th, falling to £43 next day, only to improve to £44 on the 27th. From this point values again declined to £42 15s. on the 30th, when the definite failure of the negotiations was publicly announced; but an advance to £43 13s. 9d. has since taken place, the strong position of Copper, irrespective of any limitation of supplies, becoming generally apparent. The total transactions of the month exceed 50,000 tons.

There is little doubt that the private stocks of Copper in France and Germany are very small, and that the public stocks in England and France will steadily diminish in order to supply the increasing consumptive demand.

English Best Selected Ingots sold up to £48, closing at £47 per ton. For *Lake Superior* Ingots £51 was paid, but the present value in New York of 10.75 cents per lb. (an advance of 1 cent) is the equivalent of about £53 per ton; and of *Electrolytic* Copper about £52 5s. per ton, Birmingham terms, little being offered for sale.

May 6—	11 tons	Precipitate	Spanish	about 70%	at Liverpool	on private terms.
" 13—	37 "	Ore	Chile	" 20%	at Swansea	at 7s. 9d. per unit.
" 22—	155 "	Ore	Chile (*Carbonate*)	" 20%	at Liverpool	at 8s. 4½d. per unit.
" 22—	300 "	Ore	do do	" 20%	to arrive at Liverpool	at 8s. 4½d. per unit.
" 22—	1,400 "	Ore	Mason's (44% Sulphur)	6%	at Liverpool	on private terms.
" 23—	11 "	Precipitate	Spanish	70%	to arrive at Liverpool	on private terms.

QUOTATIONS to-day are: Chile Bars and Good Merchantable Copper £43 13s. 9d. for cash, and £44 1s. 3d. for three months' prompt. Buyers. English Best Selected Ingots £47 10s. to £48, and Tough Cake £47 to £47 10s. per ton. 8s. 6d. for Ore of 20 per cent., and 8s. 9d. per unit for Chile Regulus or American Matte, free from Silver.

CHILE EXPORTS to 31st May are:—

	1890.	1891.	1892.	1893.	1894.	1895.
EXPORTED to 31st March	6,237	4,839	5,264	4,704	4,734	4,573
LOADING on do	562	....	....	....	50	....
CHARTERED to 31st May	4,351	3,008	3,761	3,367	3,497	5,029
	11,150	7,847	9,025	8,071	8,281	9,602 Tons Fine.

STOCKS of Copper—(Tons Fine)

	1st June, 1890.	1st June, 1891.	1st June, 1892.	1st June, 1893.	1st June, 1894.	1st April, 1895.	1st May, 1895.	1st June, 1895.
CHILIAN in *Liverpool and Swansea*	16,341	18,348	30,057	30,855	32,547	38,683	39,525	39,519
France	27,650	15,973	3,895	3,489	508	270	282	550
AMERICAN in *Liverpool and Swansea*	12,658	979	3,172	1,925	3,919	3,580	3,604	3,437
France	3,230	603	—	909	324	389	337	907
SUNDRIES in *Liverpool and Swansea*	3,016	1,780	2,060	1,868	1,265	1,498	1,412	996
London	5,557	7,558	7,493	6,926	5,046	5,021	4,895	4,398
France	3,878	789	689	410	169	244	184	154
ENGLISH G. M. C. in *Liverpool and Swansea.*	5,383	2,714	2,599	169	2	—	—	—
Total	77,713	48,744	49,965	46,551	43,780	49,685	50,239	49,961
AFLOAT as advised by Mail and Cable to date:—								
From Chile	3,854	2,597	3,172	2,609	3,135	2,501	3,199	3,486
" Australia	500	1,000	600	800	700	1,150	1,000	1,100
TOTAL VISIBLE SUPPLY	82,067	52,341	53,737	49,960	47,615	53,336	54,438	54,547
QUOTATIONS. Bars, per ton	£54 10 0	£55 5 0	£46 12 6	£43 2 6	£38 13 9	£39 11 3	£41 0 0	£43 13 9
Ore, per unit	10/6	10/3	8/10½	8 7½	7/1½	7 7½	7/10½	8/6

IMPORTS of Copper (exclusive of Pyrites and Precipitate to Outports) from 1st January to date:—

	1890.		1891.		1892.		1893.		1894.		1895.	
Chile into Liverpool and Swansea	10,238		5,333		6,879		7,487		7,024		7,314	
* Other Countries into Liverpool and South Wales	24,698		29,278		26,437		20,181		24,332		18,356	
" " " London	119		391		790		455		1,108		467	
Australia " "	2,832		1,922		2,205		2,909		2,715		3,481	
Japan " "	3,075		3,033		1,094		1,574		698		2,684	
		40,962		39,957		37,405		32,606		35,872		32,302
Chile into France	570		2,287		1,020		1,657		1,137		1,379	
America "	932		2,798		1,460		2,200		2,605		3.432	
Mexico "	—		—		—		2,530		3,215		2,165	
Other Countries into France	288		399		487		1,326		502		725	
		1,790		5,484		2,967		7,713		7,459		7,701
		42,752		45,441		40,372		40,319		43,331		40,003 Tons Fine.
DELIVERIES..ditto..in England and France		58,385		52,040		43,051		47,833		42,296		40,806 Tons Fine.

* *IMPORTS of other than Chile Copper* into Liverpool and South Wales during the *first five months* of the following Years:—

	1890.	1891.	1892.	1893.	1894.	1895.
From United States	9,737	12,839	10,377	9,143	13,370	8,640
" Canada	47	27	—	—	80	—
" Mexico	259	1,895	350	474	702	450
" Peru	57	83	79	185	223	86
" River Plate	50	95	117	56	94	71
" New Quebrada	1,495	1,641	2,365	598	884	360
" Newfoundland	200	80	703	321	—	—
" Spain	1,744	1,455	1,792	1,984	1,154	1,267
" " (Precipitate)	6,738	7,648	6,959	4,463	4,704	4,798
" Portugal	123	104	373	143	483	161
" Italy	315	300	303	375	316	148
" Norway	8	5	36	—	—	236
" Cape of Good Hope	3,788	3,081	2,769	2,092	2,232	1,858
" Australia	29	13	—	88	—	—
" Sundries	108	12	214	259	90	281
	24,698	29,278	26,437	20,181	24,332	18,356 Tons Fine.

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Silver advanced from 30¼d. to 30⅞d. on the 13th, and after slight fluctuations closes at 30 9/16d. per ounce standard.

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Antimony—£31 10s. to £32 per ton.

Nickel offers at 1s. 1d. to 1s. 2d. per lb. net.

Tin rose from £64 to £67 on the 13th, declining again to £64 per ton—the closing value.

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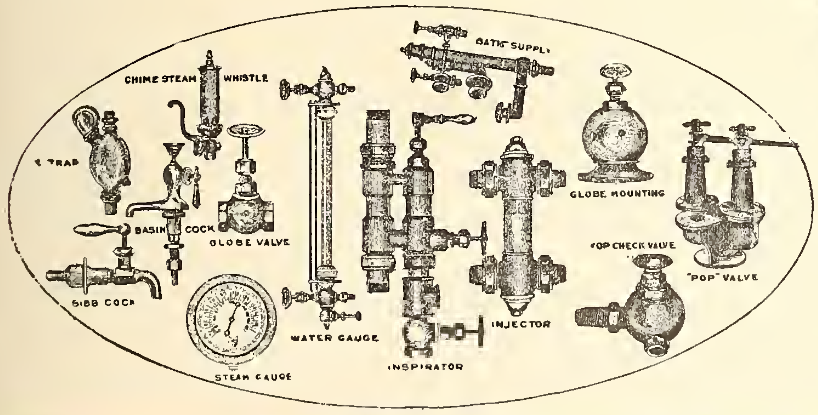

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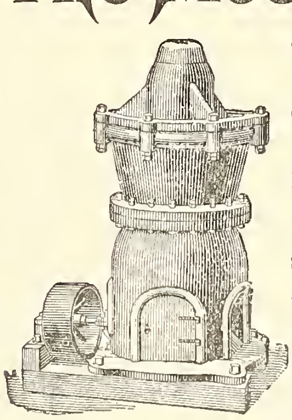

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IN THE CHATEAU FRONTENAC, QUEBEC,

Thursday and Friday, June 27th and 28th, 1895.

Under the Auspices of the GENERAL MINING ASSOCIATION OF THE PROVINCE OF QUEBEC, there will be held a United Meeting of

The Mining Society of Nova Scotia, The Asbestos Club, The Ontario Mining Institute, and The General Mining Association of Quebec.

Meetings—Thursday Evening at 8 o'clock.

BUSINESS SESSION OF INDIVIDUAL SOCIETIES AT EIGHT O'CLOCK.

OPEN SESSION AT 8.30.
The Hon. E. J. Flynn, Commissioner of Crown Lands, in the Chair.

THE DEVELOPMENT OF OUR PHOSPHATE AND FERTILIZER INDUSTRIES. WHY THEY SHOULD BE ENCOURAGED.

(*a*) Phosphoric Acid in Agriculture.
By FRANK T. SHUTT, Chief Chemist, Dominion Experimental Farm, Ottawa.

(*b*) Canada—A Natural Manufacturing Centre for Fertilizers.
By MR. HENRY WIGGLESWORTH, New York.

(*c*) Phosphate's Future.
By CAPT. ROBT. C. ADAMS, Montreal.

RECENT IMPROVEMENTS IN, AND THE APPLICATION OF ELECTRICAL MACHINERY TO MINING (Illustrated).
By MR. W. F. DEAN, Montreal.

Excursions—Friday, June 28th.

On Friday morning, leaving the Chateau Frontenac at 10.30 a.m., there will be an excursion by Caleche to the principal points of interest in and around historic Quebec.

In the afternoon, at three o'clock, the members and their friends are invited by Messrs. Carrier, Lainé & Co., of Levis, to an excursion by special steamer, visiting the Chaudiere Falls, the Falls of Montmorenci, the Dry Dock, and the large engineering works of their firm.

Any business or papers left over from the meetings on Thursday will be finished at an evening session in Chateau Frontenac at eight o'clock.

Saturday Morning—Excursion to Lake St. John and the Saguenay.

It is proposed, provided a sufficient number of members and their friends are available, to have an excursion to Lake St. John and the far famed Saguenay, leaving via Quebec and Lake St. John Railway, St. Andrew Street Depot, on Saturday 29th June, at 8.30 a.m. There is first-class hotel accommodation at Roberval, delightful scenery and famous fishing. Sunday and Monday (Dominion Day) will be spent here, and on Tuesday the boat will be taken at Chicoutimi for the excursion down the Saguenay, arriving at Quebec the same evening.

Clubs.

By courtesy of the President and Members, members of the visiting associations have been extended the priviliges of the Union and Garrison Clubs during their stay in Quebec.

Hotels.

By special arrangement reduced rates for members have been secured as follows:

Chateau Frontenac	$3 50
Florence House	2 00
Hotel Victoria	2 00

Transportation—Railways and Steamers.

INTERCOLONIAL RAILWAY OF CANADA—Members from Halifax and points on this line will, it is hoped, be carried to Levis and return for a single fare.

QUEBEC CENTRAL RAILWAY—Members from Sherbrooke and points on this line will be carried to Levis and return for a single fare on presentation of official Circular.

CANADIAN PACIFIC, GRAND TRUNK AND CANADA ATLANTIC RAILWAYS By special arrangement, members and their friends will be carried the round trip over these lines at a greatly reduced rate on obtaining Convention Certificate from Ticket Agent and on same being signed at Quebec by the Secretary. DO NOT FAIL TO ASK FOR IT AND ONLY BUY A SINGLE TICKET.

RICHELIEU AND ONTARIO NAVIGATION CO. (Boat service)—By special arrangements reduced fares as follows (exclusive of meals and berths):

	ONE WAY.	RETURN.
From Toronto to Quebec	$7 00	$13 00
From Kingston to Quebec	5 00	8 25
From Montreal to Quebec	2 50	4 00
From Chicoutimi to Quebec	2 75	

A cordial invitation to be present is extended to all interested in the mineral development of the Dominion.

JOHN BLUE,
President.

B. T. A. BELL,
Secretary.

NOW READY.

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PART II.

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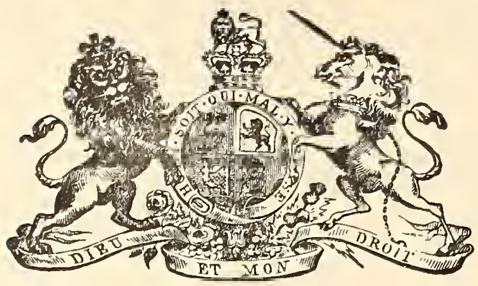
An authentic statistical summary of the Production, Imports, and Exports of Iron and Steel, and the Bounties paid to producers of Canadian Pig Iron up to the 4th April, 1895; together with information respecting the organization, equipment and operations of the Iron Mines, Blast Furnaces, Rolling Mills, Locomotive and Engine Shops, Bridge Building, Pipe, Stove and Agricultural Implement Foundries, Car Wheel Works, Tools, Cars and Carriage Builders, Mining and Electrical Machinery and other prominent Canadian Manufacturers and Consumers of Iron and Steel.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The Canadian Mining Review

Established 1882

Vol. XIV.—No 7 | 1895—OTTAWA, JULY—1895 | Vol. XIV.—No. 7.

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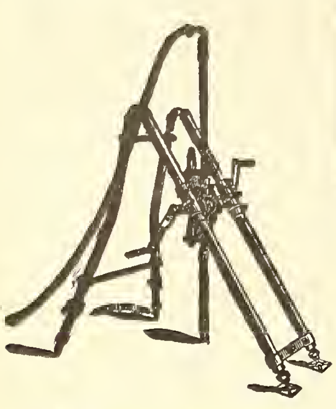

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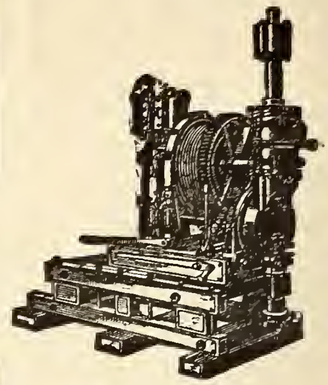

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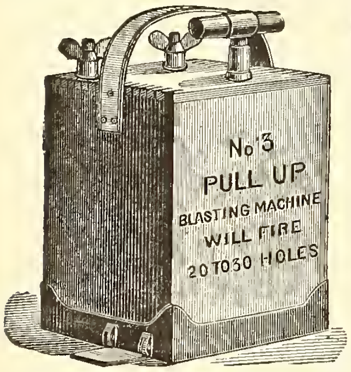

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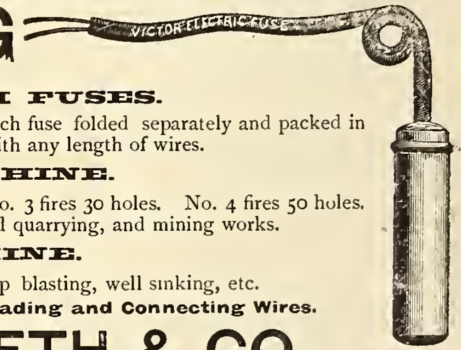

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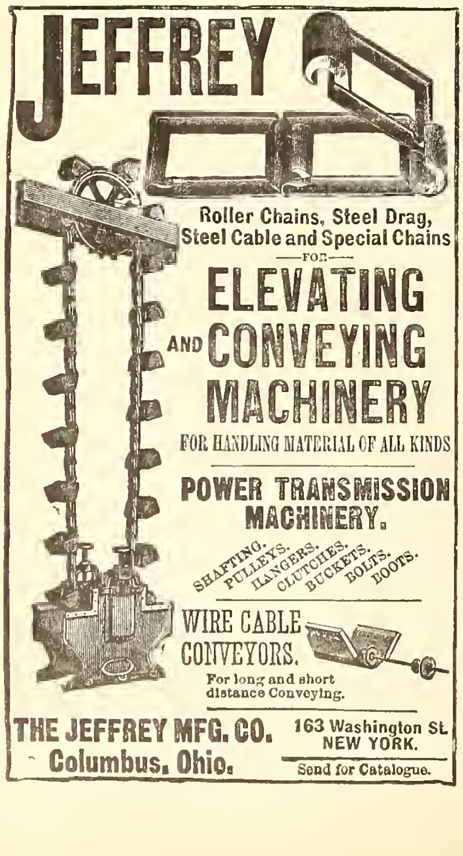

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Royalty not charged until seven years from date of patent or lease, nor (as provided in s. 4 (3) of the Mines' Act, 1892), until fifteen years in the case of an original discovery of ore or mineral.
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Copies of the Mines Act, 1892, Amendment Act, 1894, may be had on application to

ARCHIBALD BLUE,
Director Bureau of Mines

TORONTO, May 25th, 1894.

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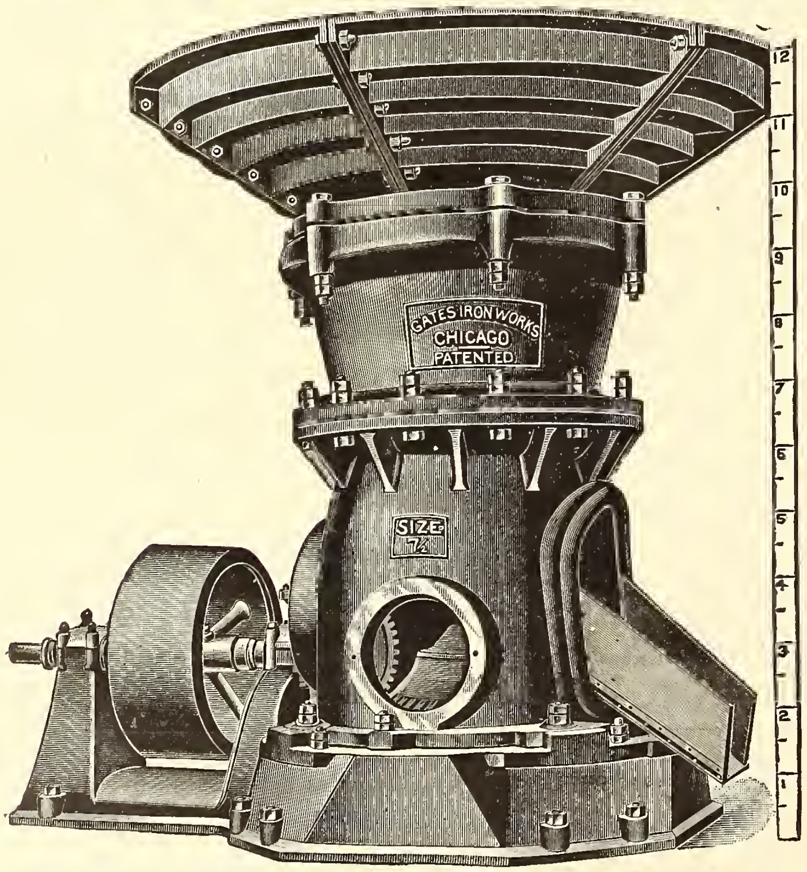
Of the aggregate of costs and charges above enumerated, excepting the sixth item, forty per cent. will be borne by the Bureau of Mines in 1894, thirty-five per cent. in 1895, thirty per cent. in 1896, and twenty-five per cent. in each year thereafter until the end of 1900. All accounts payable monthly.

For Rules and Regulations *in extenso* governing the use by companies and mine owners of Diamond Drills, or other information referring to their employment, application may be made to ARCHIBALD BLUE, Director of the Bureau of Mines, Toronto.

A. S. HARDY,
Commissioner of Crown Lands.

Toronto, October 17, 1894.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The Canadian Mining Review

Established 1882

Official Organ of The Mining Society of Nova Scotia; The General Mining Association of the Province of Quebec; The Asbestos Club; and the Representative Exponent of the Mineral Industries of Canada.

B. T. A. BELL, Editor. Published Monthly. OFFICES: Slater Building, Ottawa.

VOL. XIV., No. 7 JULY, 1895. VOL. XIV,, No. 7

The Ou'look for Canadian Phosphates.

It is only necessary to remember that the products of nature are the sole sources of our food, and that they at the same time furnish all the raw materials of art, in order to understand that agriculture is the rock upon which nations build their riches. The Canadian farmer is made of the same material as the great majority of his class. If he were left to himself, his methods of work would differ but in trifling details from those of the ancient Romans. He continues to draw upon his immense natural reserves without a thought of the future, and it is only when crops begin to fail, and general signs of exhaustion begin to make themselves manifest, that he consents to listen to the teachings of science. Even then he is too prone to look with suspicion and distrust upon those who would enlighten him. He admits the facts, but cannot understand the reason why his annual crops are no longer so abundant, nor of so good a quality as they were thirty or forty years ago.

This ignorance cannot, of course, continue, because we live in an age of thought and rapid intercommunication. The last barriers of prejudice must be beaten down by experience and example, and before long every farmer must realize that agriculture can only remain a profitable pursuit on the condition that he yearly obtains from his acres a maximum and cheap return. In order to succeed in this, he must restore to the soil those elements which it once contained in abundance, but which, in the process of nourishing the plants, have been partially taken away.

It has been definitely and satisfactorily established, that the food value of all vegetable growths is derived from their starch, gluten, sugar, gum and some organic acids, while the value of animal food is due to albumen, fibrine, fats and small quantities of divers saline matters. All these constitute what are known as proximate principles, the ultimate composition of which is made up of such simple bodies as carbon, hydrogen, oxygen, nitrogen, calcium, potassium, sodium, iron, phosphorous and sulphur. This proves conclusively that the elements of our food are taken from the air, the water and the soil, and so fitted together by the plants as to produce the food of those animals termed graminivorous, which, in their turn, afford to us the vast bulk of our animal sustenance.

Some rough idea of the actual quantity of mineral matter annually withdrawn from the soil by our food plants, may be arrived at if we take a given weight of any cereal, say, for instance, wheat, and burn it until it is reduced to a perfectly white ash. If we next weigh this ash very carefully, we shall ascertain that its weight will represent about two and one-fourth per cent. of the material burned, and if we make a chemical analysis of it, we shall find it to be mainly composed of phosphates of potash, magnesia and lime.

It has been estimated, in a rough and essentially approximate manner, that the total area of soil under cultivation for cereals and grasses, in North America, and in Europe, is 1,000,000,000 acres, and that the crops attain an average of about one ton per acre. It has also been roughly estimated that the average depth of the soils over this area is in the neighborhood of nine inches, and analyses have shown that their average contents in phosphates are about 4,000 pounds per acre. The total amount of phosphates contained in these soils is, therefore, 2,000,000,000 tons.

If every ton of crop deprives the soil of at least forty pounds of phosphate, as it certainly does, it follows that the 1,000,000,000 tons of crop use up 20,000,000 tons of phosphate every year. As the natural effect of our social and sanitary arrangements, only about half this quantity is recovered from the refuse of farms and cities and returned to the soils; the other half is carried away and lost. This creates a yearly deficit of 10,000,000 tons of phosphate, and in the ordinary course of events the lack of this most essential constituent would entail sterility of all these soils in the next 200 years.

This very serious fact has led to the use of a number of phosphatic substances for the purpose of restoring fertility to the lands, but it has been proved that the total quantity of such substances used in various forms does not amount to more than about one-third of the average amount yearly drawn from the soil, and it consequently follows that there is an actual and crying necessity for at least three times the present consumption of natural phosphates.

The phosphate deposits of Canada are exceptionally rich, and exceptionally extensive, and that they are so has been known for a considerable number of years. They have been more or less extensively exploited by various companies which have been formed for the purpose, but have hitherto been of no direct benefit to Canadian agriculture, since they have been sent abroad and sold in European markets. This is the reason why so few of the mining companies have ever paid a dividend on their capital. The demands of the European market have been confined to the highest obtainable grades of Canadian phosphates. With these high grades, the European fertilizer manufacturers have been able, by judicious mixtures, to enrich and make marketable the poorer qualities of phosphate produced in their own countries. So long as Canada was the sole producer of phosphates ranging from 80 to 90 per cent., as she virtually was up to within a period of five or six years ago, her miners continued to spoil her mines, and to squander her resources in order to supply this unfair demand; but, in the year 1888, the discovery was made in Florida of enormously rich and accessible deposits of phosphate rock, and from that date down to the present time, the mining of phosphate in Canada has gradually dwindled away, and has now become a dead letter. As this result has not only involved the loss of large capital, but has thrown a very large number of miners and laborers out of employment, it is worth while to look a little more closely into the circumstances which have slowly, but surely, led up to it

It will be remembered that the first serious attempt to develop the phosphate mines of Florida was marked by the outbreak of a perfect fever of speculation. The difficulties between the Coosaw Company and the South Carolina State authorities had only just arisen, and as the temporary suspension of this company's gigantic operations threatened a considerable decrease in production, buyers became anxious to secure their needed supplies, and the miners advanced their prices. To the initiated, this was an intelligible and natural situation : on the one hand there was the deficiency by the Coosaw Company; on the other, there were the customers of this company anxious to supply their needs and ready to abide by a rise in price rather than be left unsatisfied. A fictitious activity was thus imparted to the entire phosphate industry, of which few, if any, of those who rushed into the Florida fields took the trouble to ascertain the true inwardness. They ignored the all-important fact that the actual demand for consumption of the entire world for mineral phosphates does not attain more than 2,500,000 tons, including all kinds and qualities. They repeated the mistakes of the Canadian miners; and, in lieu of awakening the interest of American farmers, turned their attention to Europe as a more proper, because supposed unlimited, consumer.

The result of such a "boom" and of such ignorance has been widespread and deplorable. The foreign buyers who were at first so skeptical of the existence and value of these Florida deposits, became seriously concerned at their abundance, and their anxiety for future supplies changed to apprehension when they saw themselves menaced with a glutted market. They knew and understood the impossibility of finding an outlet, in any of the ordinary channels of trade, for such a flood of material as that with which they became threatened, and they took advantage of their knowledge to break the market. So thoroughly did they master the situation that the hapless miners are now entirely at their mercy, and we are confronted by quotations which have not only closed Canada's mines, but have brought ruin to the miners of South Carolina, despite their natural advantages.

Nor must it be supposed that this state of affairs has resulted in a serious increase in the consumption of American phosphates. In the year 1890, for example, the total output from all the American mines amounted to about 600,000 tons, and the average prices were $5 per ton for that which contained 60 per cent., and $10 per ton for that containing 75 to 80 per cent. phosphate of lime, both free on board cars, at the mines.

In the year 1892 the sales were increased by 18 per cent., or in other words, there were sold about 700,000 tons. This surplus of only 100,000 tons had such an extraordinary effect upon the markets of the entire world, that its disposal entailed a fall in price to $3 and $4 per ton for the respective qualities mentioned.

This remarkable disturbance caused by this slight excess of exceptionally high-grade and good quality, graphically illustrates the present want of flexibility in the fertilizer markets, and not only argues badly for the immediate future, but should be a significant warning to producers not to overstep the bounds of prudence.

This warning is additionally emphasized by the recent discoveries of inexhaustible deposits of excellent phosphates in Algiers and Tunis, which can be very cheaply mined and marketed, and it is a very serious question whether the disturbed equilibrium can be restored, and whether phosphate mining can ever again become an exceptionally profitable undertaking. The operation of the law of supply and demand is always absolute and inflexible, and it is now making itself felt in this, as in every other phase of commercial affairs.

The only avenue of escape left open to the phosphate miners of Canada is in the direction of creating a local market for their product, and especially for their lower qualities, which, while the cost of transportation would render them unfit for sale in England or Germany, are just what is required for the manufacture of fertilizers for home consumption. It would certainly be wiser policy for Canadian miners to dispense with all their present expensive processes of hand selection and cobbing, and to rest content with such an assortment at the quarry-side as would insure an average grade of, say, about 60 per cent. of phosphate. The proportion of this quality to the total matter removed from the mine would be about double that of the pure apatite which has hitherto been solely sought after, or to put it in other words, instead of ten, their output could be placed at nearly twenty per cent. without increase of cost.

The phosphate miner, as we have seen, does not sell his product to the farmer, but to the manufacturers of fertilizers, who first grind it to an extreme fineness, and then mix the powder with about its own weight of weak sulphuric acid. A more or less soluble article is thus obtained, which is the basis of all artificial fertilizers, and which is popularly known as superphosphates. The reason why this acidulated compound is preferred to the raw material is to be found in the generally admitted fact that Cansdian apatite is very sparingly and very slowly soluble in the water in the soil, and that no element can penetrate into the interior of a plant unless it be in solution.

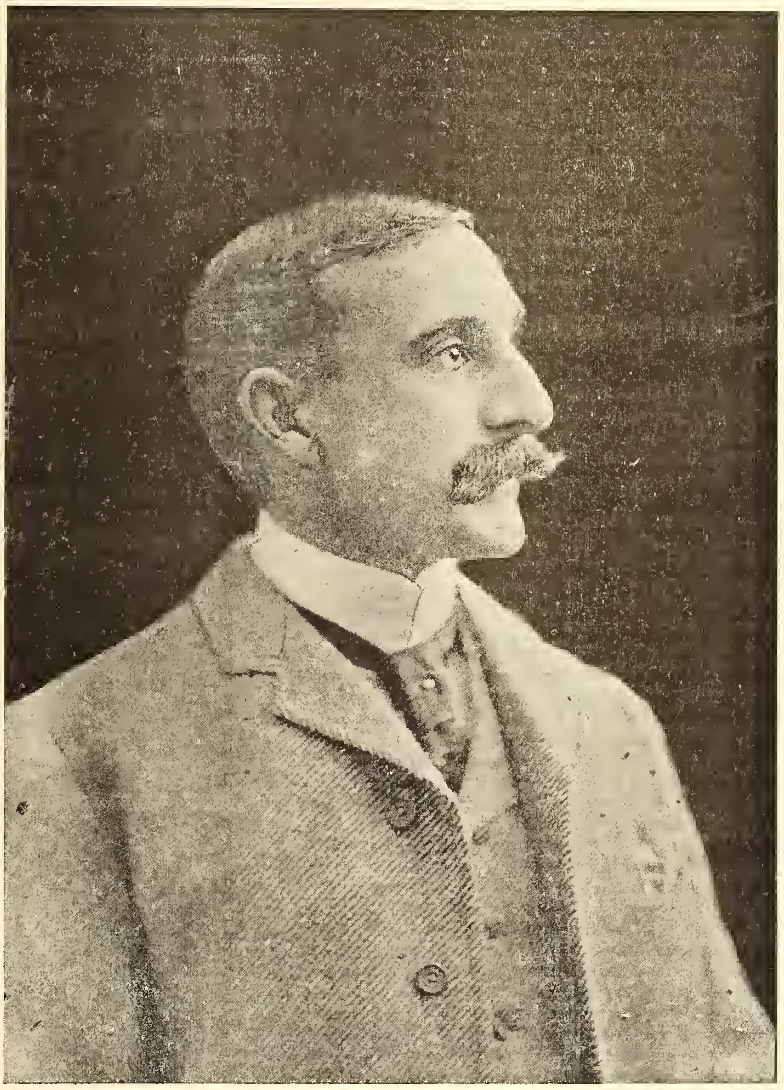
A great many attempts to use it as a direct fertilizer have demonstrated that its availability entirely depends upon the fineness of the powder to which it may be reduced, and the nature and composition of the soil in which it is to be employed, and it is a matter of the greatest difficulty to attain the requisite degree of disintegration by any sufficiently cheap mechanical means. In this respect we are, in fact, not very much farther forward now than we were in 1857, when Liebig recognized the difficulty and proposed to solve it, by adopting a chemical method of decomposition which enabled the farmer to obtain practical results from the use of mineral phosphates within one year, instead of waiting three or four. That the chemical treatment does not in reality do anything more than break up the primary molecular formation of the tricalcic phosphate, is proved by the fact that superphosphate of lime is only soluble in water so long as the mono-calcic form retains its ascendency. Directly it reaches the soil, especially where carbonates are in abundance, the free phosphoric acid unites with various earthly bases and becomes insoluble. To put it plainly, therefore, the issue so far as the farmer is concerned, revolves upon a matter of time and of money. He might buy a ton of raw phosphates, ground as finely as possible, and containing, let us say, fifty-five per cent. of tricalcic phosphate for $10. If his land were tolerably acid, and this of course is seldom the case, he might get a rapid return; but if it were not, his raw phosphate would only decompose very slowly, and he would have to wait several years before obtaining any appreciable results from his outlay. On the other hand, if he buys a ton of superphosphates for $20, containing only thirty per cent. of calcic phosphate made soluble, and applies it to a phosphate-barren soil, he produces the desired effects on his crop the same year. The mere decomposition of the tricalcic phosphate into the acid salt ensures an absolute state of division which is maintained despite the subsequent reversion, and an intimate and immediate contact with the acid sap of a greater number of root hairs being thus facilitated, the ready absorption of the dissolved phosphate by the plant is naturally assured

These views will be endorsed by all the officials of the agricultural experiment stations who have made the comparative use of the finely ground raw mineral phosphates and of superphosphate; their results with the former having fully confirmed the conclusions formulated in 1857 by De Molon, who, after very extensive trials of ground raw coprolite in many different departments of France, said that:—

(1) Raw phosphate might be used with advantage in clayey, schistous, granitic and sandy soils rich in organic matter.

(2) If these soils were deficient in organic matter, or had long been under cultivation, it might still be used on them in combination with animal manure.

The term soluble, as applied to phosphate, must be accepted in a relative sense, and the use of both raw and manufactured articles is a matter which calls for intelligent discrimination on the part of the farmer. He might find that in one portion of his lands raw phosphates mixed with his compost heaps would soon dissolve and yield very profitable and rapid returns, while in another portion, owing to a different constitution of the soil, they would remain inert for an indefinite period.



Mr. J. R. COWANS, Springhill, N. S.,
General Manager, Cumberland Railway and Coal Company, Ltd.

Within the past few years, the rapid development of the fertilizer industry has led to the introduction of a concentrated material known as "high grade supers," which is made to contain forty-five per cent. of phosphoric anhydride (P_2O_5) in a "water" and "citrate" soluble form, and which should soon entirely supplant the weaker "supers" in general use. The plan upon which it is produced is perfectly scientific and rational, since it consists in dispensing with oil of vitriol and using in its place phosphoric acid as the solvent of the raw phosphate.

In the manufacture of superphosphates as now carried out, the desired solubility, either in water or in citrate of ammonia, is attained at the cost of doubling the bulk of the raw material by the addition of sulphuric acid, which practically serves no other purpose and has no other value than that of a dissolvent. If such raw material, therefore, contain sixty per cent. of tricalcic phosphate, the "super" can only contain thirty per cent., and this, from the agricultural consumer's standpoint, is certainly an anomaly, and, apart from any question of solubility, must remain so for two reasons :—

(1) A ton of sixty per cent. phosphate of lime, finely ground, but insoluble in water or citrate of ammonia, can be purchased at some central point for say $10.

(2) A ton of superphosphate, containing only thirty per cent. phosphate of lime, cannot be purchased at the same spot for less than $15.

In the one case, freight is paid upon only forty per cent. of waste material, whereas in the other, it is paid upon seventy per cent. of practically valueless matter.

That a legitimate profit should attach to the manipulation of an inert, and its transformation into an active body, is beyond question, but there is no reason why such enormous and unreasonable benefit should be derived from the trade in fertilizers by the railroad companies or other public carriers.

The reactions involved in the process of superphosphate mixing have served to demonstrate that the cheapest and best known method of making liquid phosphoric acid from calcic phosphates is by driving it from its combination with lime by means of the stronger oil of vitriol, and by utilizing many low-grade phosphates which now, for lack of a sufficiently cheap freight, have practically no market value.

The feasibility of treating Canadian low-grade phosphate ores was very fully discussed at the Baltimore meeting of the American Institute of Mining Engineers, in February, 1892, and it has been demonstrated on the small scale that in comparison with our present staple superphosphate, which barely contains the equivalent of thirty per cent. of bone phosphate of lime made soluble, it has the advantage of a lower manufacturing cost, and contains the equivalent of ninety-nine per cent. or more than three times as much bone phosphate of lime, made equally as soluble and available. It could, therefore, be distributed at an economy of two-thirds of the freight now actually paid for useless material, and this is a consideration of the highest consequence, since the farmers must all have phosphate, and since the raw material is confined to an area somewhat remote from the large mass of consumers.

If the present results of phosphate mining enterprises have been very disappointing and discouraging, that fact should only spur us on to exercise all our ingenuity in order to make our products more available for the world's needs.

EN PASSANT.

We regret to record this month the sudden and untimely death of Mr. J. Fraser Torrance, Mining Engineer, of Montreal. The deceased gentleman was a graduate of McGill, and was for a number of years, we believe, on the staff of the Canadian Geological Survey. Mr. Torrance, who was engaged in opening up a gold claim for Montreal capitalists in the Rat Portage district, was found dead in bed in his cabin at the mine.

Mr. J. Keith Reid, Montreal, has just issued an excellent map of the Slocan mines, Kootenay district, British Columbia, which, we are confident, will be found of great service by mining men and capitalists interested in that important mining country. The map has been compiled from special surveys and is beautifully lithographed in colors, the size being 36 x 60 inches.

Mr. A. Blue, and his associates in the Bureau of Mines, Toronto, are to be commended for the prompt issue of their report upon the mineral industries of Ontario for the year 1894. The volume, as in former issues, contains much serviceable statistical information, as well as a number of valuable contributions bearing upon the occurrence of minerals and their exploitation in the province, the whole excellently gotten up and handily indexed for reference. In his opening remarks Mr. Blue says: "The statistics of the sale and lease of mineral lands, as well as those of the production of ores and other minerals, indicate a condition of inactivity in the mining industry of the province which is no doubt a consequence of the depression in business and inertness of speculation so noticeable in other countries, but especially in Great Britain and the United States, where mining enterprise has heretofore been so brisk. Signs of revival however are beginning to appear in those countries, and increased attention is likely to be given to mining operations here as well as elsewhere. The gold fields of the province are attracting greater notice, and during the past year the Rainy Lake region especially drew many explorers and capitalists towards it. Numerous discoveries of gold-bearing ore are reported there, four or five locations are being actively developed, and one gold-mill is nearly ready for operation. In the Lake of the Woods district the mine and mill on Sultana Island have been worked continuously, and it is claimed that free-milling ore is obtained throughout the entire extent of the workings, now about 200 feet underground. Three other promising properties are in course of development with British, American and Canadian capital, and it is proposed to put a mill on each of them this year. At the present time a mill is in course of erection at Harold lake, near the upper waters of the Seine river. The Ophir mine and mill in Galbraith township were operated only during a portion of the year, owing, it is said, to an insufficiency of paid-up capital; but the engineer in charge claims that the work done in the mine has proven it to be a good property. The death of one of the principal shareholders, which occurred recently, will doubtless for a time leave the affairs of the company in an unsettled state. The Creighton mine in the township of that name was idle the whole year, but towards the close of it fresh exploratory work was commenced with a diamond drill, and it is reported that a strike of considerable promise has been made; operations to more satisfactorily prove the extent and quality of the ore body are now in progress. In the Lake Wahnapitae district a location taken up by Mr. Rinaldo McConnell of Mattawa has attracted much attention by the exceedingly rich samples of ore taken from it. A company has been organized to work the property, and a shaft is in course of being sunk upon the vein. In the Marmora district little has been done. Only one property, the Ledyard mine in Belmont, was worked during the year. Some good ore was raised, and a second-hand Huntington mill was set up, which however, gave little or no result. A new Huntington mill has been purchased, and will be running in the course of a few weeks. The gold mill built at Marmora to treat arsenical ores by the Walker-Carter process has been closed down for want of ore to treat. Early in the year the staff of the Bureau was strengthened by the appointment of Dr. Arthur P. Coleman, of the School of Practical Science, as geologist and mineralogist. Dr. Coleman is required to occupy three of the summer months in geological field work and to make a report thereon, besides other duties of an advisory or special character which do not interfere with his professional functions at the school. Last summer was occupied by him in examining the Rainy Lake gold-field, and the belt of country northward of it along the Manitou and Wabigoon waters to the line of the Canadian Pacific Railway. His report and the geological maps accompanying it will be found especially valuable to prospectors in that field. The maps have been prepared in the office of the Director of Surveys. The one of the Rainy Lake district is based upon the map of the Geological Survey accompanying Dr. Andrew C. Lawson's report of 1887-8, with additions showing recent surveys of townships and mining locations from the office maps in the Department, and some corrections in the geological coloring by Dr. Coleman. The map of the Manitou and Wabigoon rivers tract is prepared from departmental surveys. The nickel and copper mines in the Sudbury region have been actively worked during the year, and as the statistics show the production of matte was much larger than in either of the tpreceding years. wo It is gratifying to know that the severe tests to which nickel-steel armor plate has been subjected continue to show its superiority to all other kinds of plate. Development work was carried on at the Point Mamainse copper locations on Lake Superior for the greater part of the year, and as a result of the extent and richness of the finds of ore it is expected that substantial mining operations will be undertaken this year. The growing interest taken in our northern Ontario, both as a field for settlement and mining enterprise, required that all the trustworthy information relating to it in many volumes of official reports and elsewhere should be searched out and presented in suitable form. This work has been undertaken by the secretary of the Bureau, Mr. T. W. Gibson, and the valuable paper on The Hinterland of Ontario is the result of his labors. The diamond drill purchased by the Government last year and placed in charge of the Bureau has been steadily employed since the time that it passed the customs in exploring an iron-ore property in the County of Frontenac. Information as to the steps taken to select and purchase the drill and the work done with it is presented in the report. There are sanguine hopes, it may be added, that the iron industry will assume active form in the province this year. At the last session of the Legislature provision was made for summer mining schools at Sudbury and Rat Portage, at which practical instruction might be given for the benefit of miners, prospectors and others employed or interested in mining pursuits. Classes were opened at Sudbury, Copper Cliff and Rat Portage, with an aggregate regular attendance of fifty-one. The report of the instructors in charge shows the scope and character of the work undertaken, and the favor with which the project has been received."

A decision of the utmost importance to shareholders and speculators has recently been delivered by the Judicial Committee of the Privy Council—the court of last resort for Britons. It settles definitely and forever the long disputed point whether "buying for a rise and selling for a fall" is or is not a gambling transaction in the eye of the law. From 1882 to 1886 a Montreal broker named Forget effected deals in stocks and shares for a clerk named Ostingy, a man of small means. In 1890 a balance appears to have been struck, showing Ostingy indebted to Forget in nearly £400. In each of two trials in the courts the shareholder was worsted, the judges holding the view that the transactions partook of the nature of a gamble, and established no debt which a court of law would recognise. Ostingy pleaded the statute of limitations, but his principal defence was, that the orders being given without any real intention of buying stocks, the transactions were illegal and could not form the basis of an action. The Lord Chancellor, who delivered judgment, dissented in toto from the finding of the Canadian courts. It did not matter (he said) whether the broker knew that Ostingy's object was speculation and not investment. Such contracts were sometimes spoken of as "gambling on the Stock Exchange," but it certainly did not follow that the transactions involved any gaming contract. A contract could not properly be so described because it was entered into in furtherance of a speculation. It was a legitimate commercial transaction, and one of everyday occurrence, to buy a commodity in the expectation that it would rise in value, and with the intention of realizing a profit by its re-sale. The legal aspect of the case was the same whatever be the nature of the commodity, whether it be a cargo of wheat or the shares of a joint stock company. Nor, again, did such purchases and sales become "gaming contracts" because the person purchasing was not possessed of the money required to pay for his purchases, but obtained the requisite funds in a large measure by means of advances on the security of the stocks or goods he had purchased. That also was an everyday commercial transaction. After other observations, the Lord Chancellor said their Lordships thought the judgment of the courts below ought to be reversed, with costs. But in regard to the costs of the appeal, they considered that as Forget was allowed to prosecute it, notwithstanding the small amount at stake, upon the ground that it involved a question of wide general interest, he (Forget) should bear the costs of the appeal on both sides.

In comparing the four great tunnels, it is interesting to note, says the *Chautauquan*, that time is an extraordinary element in the cost. The oldest tunnel—Hoosac—cost $379 a foot; Mount Cenis, the next oldest, cost $356 a foot; St. Gothard cost $229 a foot, and the most recent tunnel of the four—the Arlberg—cost only $154 a foot. All four were in old-settled countries, with abundant labor, and the very great difference in cost per foot plainly marks the progress of science, because it was the invention and improvement of tools that made it possible to reduce the time and thus the cost. To observe the difference between the work on the three great European tunnels, built by government aid in old-settled countries, it may be well to observe for a moment the work done on a comparatively small tunnel built far from civilization through the Cascade Mountains on the line of the Northern Pacific Railroad. The mountain through which the tunnel runs is 3,790 feet above the sea, and the peak is 1,135 feet above the floor of the tunnel. To understand the magnitude and difficulty of this undertaking it must be observed that the site of the tunnel, at the time the contract for its construction was signed, was an unbroken wilderness. At the then existing terminus of rail connection everything—men and tents, food, horses, machinery, lumber, hospitals, and, in fact, the material of the army—had to be transported over improvised roads 82 miles, through forests through snow and mud, to the east portal of the tunnel, and 87 miles to the west portal. Six months passed before the machinery was on the spot. Rivers had to be turned aside, bridges built, camps established and men and horses collected, fed, housed and cared for nearly 100 miles from a locomotive. The tunnel is 16½ feet wide and 22 feet high, and the entire distance (8,950 feet) was bored through the mountain in 22 months, the rate of progress with the power drills being 413 feet a month, and the cost of the completed tunnel was only $1 18 a foot, and the entire work was completed in 28 months from the signing of the contract in New York city.

At its last annual meeting the Association of Manufacturers of Chilled Car Wheels requested the secretary to prepare an article to the railroad officials of the United States and Canada upon the mode of manufacture and relations they bear to economy in railway practices. The universal use of chilled car wheels upon horse and motor cars, as well as upon the steam roads, is commented on, together with the increase of output of wheels from 10 or 12 wheels per day in 1830 to the product of 100 foundries at the present time. It is stated that "probably no one article has contributed so much to economy in the railway practice of America as that of cast-iron chilled car wheels," and "that there is no other article so universally used on railways and upon which so much depends, that can be produced as cheaply and quickly, and which when worn out, represents as large a per cent. of its first cost." Mr. Lobdell gives a description of the method of manufacturing chilled wheels, including comments upon the iron used and its preparation, the character and qualities of the chilled surfaces and the process of annealing the completed wheels.

Canadian Phosphate for the Canadian Farmer—A Home Market for the Product of our Phosphate Mines in the Use of Canadian Superphosphates.

Proceedings of the Summer Meeting of the General Mining Association of the Province of Quebec.

The annual summer meeting and outing of the members of the General Mining Association of the Province of Quebec, was held in the Chateau Frontenac, Quebec, on Wednesday and Thursday, 27th and 28th June last. A number of delegates were present by invitation, from the Ontario and Nova Scotia Societies. The following were present at the proceedings:—

Mr. John Blue, C. and M. E., (Eustis Mining Co.) Capelton, Que.
Mr. R. H. Brown, M. E., (General Mining Association of London) Sydney Mines, C. B., President of the Mining Society of N. S.
Hon. E. J. Flynn, Commissoner of Crown Lands, Quebec.
Hon. George Irvine, Q. C. (Johnson's Asbestos Co.), Quebec.
Mr. James King, M. L. A. (King Bros.) Quebec.
Prof. Nicol, (School of Mining) Kingston Ont.
Mr. T. W. Gibson, (Bureau of Mines), Toronto.
Mr. G. Y. Chown, B. A., (School of Mining), Kingston.
Mr. H. A. Budden, (Intercolonial Coal Co.), Montreal.
Mr. David McKeen, M. P., (Dominion Coal Co.), Glace Bay, C. B.
Mr. George E. Drummond, (Canada Iron Furnace Co.), Montreal.
Mr. R. T. Hopper, (Anglo-Canadian Asbestos Co.), Montreal.
Mr. L. A. Klein, (American Asbestos Co.), Black Lake, Quebec.
Mr. W. T. Bonner, (Babcock & Wilcox Boiler Co.), Montreal.
Mr. Frank Darling, (Canadian General Electric Co.), Toronto.
Mr. W. F. Dean, (Canadian General Electric Co.), Montreal.
Mr. Lawrence J. Lynch, (Johnson's Asbestos Co.), Quebec.
His Worship Mayor Villeneuve, Montreal.
Mr. J. Burley Smith, (British Phosphate Co.), Glen Almond.
Mr. Daniel Smith, (Hamilton Powder Co.), Brownsburg, Que.
Mr. Frank Shutt, B. A., Sc., Chief Chemist, Dominion Experimental farm, Ottawa.
Mr. John J. Penhale, (United Asbestos Co.), Black Lake, Que.
Mr. C. E. Morgan, (Northey Pump Co.), Toronto.
Mr. J. Obalski, Inspector of Mines, Quebec.
Mr. E. B. Haycock, (Star Gold Mines), Beauce, Que.
Mr. L. G. Gendreau, Beauce, Quebec.
Mr. J. T. Dwyer, (Carrier Lainé & Co.), Montreal.
Mr. C. H. Carrier, (Carrier Lainé & Co.), Quebec.
Mr. R. W. Prittie, Toronto.
Mr. A. W. Stevenson, C. A., Montreal, *Treasurer.*
Mr. B. T. A. Bell, Editor CANADIAN MINING REVIEW, *Secretary.*
Mr. James Mitchell, (Beaver Asbestos Co.), Sherbrooke, Que.

The proceedings opened at eight o'clock in the Chateau Frontenac, the President in the Chair.

NEW MEMBERS.

The following were elected to membership:—

Mr. James Foley, (Petroleum Oil Trust Ltd.), Montreal.
Mr. W. T. Bonner, (Babcock & Wilcox Boiler Co.), Montreal.
Mr. Lawrence J. Lynch, (Johnson's Asbestos Co.), Quebec.
Mr. D. G. Loomis, Sherbrooke, Que.

STUDENT MEMBERS.

The following were duly elected student members:—

Mr. F. H. Bacon, McGill College, Montreal.
Mr. A. Boyer, Polytechnic School, Montreal.

AMENDMENT TO CONSTITUTION AND BY-LAWS.

The President gave notice of motion of amendment to Constitution and By-Laws, changing the number of meetings during the year to two instead of three as at present.

FALL MEETING POSTPONED.

On motion the autumn meeting was postponed, and the next meeting of the Association will therefore be held in Montreal in January next.

This concluded the business session.

The President having left the chair, the Hon. E. J. Flynn, Commissioner of Crown Lands for the Province and an honorary member of the Association, was unanimously voted to preside over the open session which was convened immediately on the conclusion of the business meeting.

ADDRESS BY THE HON. E. J. FLYNN.

HON. E. J. FLYNN—I desire to express my pleasure at being present at this meeting, and also my sense of the honor done me in asking me to take the chair. I have had previous experience of a meeting of this kind, having been present at the convention which took place in January 1894 in the city of Montreal. I must congratulate the Mining Association of the Province of Quebec on the good fortune that it has had in convening here in the old city of Champlain, the representatives of the various mining associations of the Dominion of Canada. From discussion comes light, and you have met here for the purpose of discussing some topics connected with the mining industry. The subject of mining is a vast subject, and one with which it would be utterly impossible to deal at one meeting of this kind. I notice, therefore, that on your programme for the present occasion you have given great prominence to one topic—that of phosphate mining, which is to be treated from three or four points of view. The practical aspect of the question is one which is certainly deserving of your attention and consideration as well as of that of the governments of the Provinces and of the Dominion of Canada, for, as you are well aware, the phosphate industry has for some time past been in a languishing condition, owing to circumstances over which neither those more immediately interested nor the governments have any control. Now, I see a new idea has been thrown out—that of having for the product of our phosphate mines, a home market. This idea is in keeping with the policy which prevails throughout the Dominion of Canada, that of preserving, protecting and developing natural resources which exist in the several Provinces, and in none in a higher degree than in the Province of Quebec. (Applause.) I desire to indorse this idea of a home market for our phosphate. It is part of the policy of the government of Quebec to develop the agricultural resources of the Province, and I regret that Hon. Mr. Beaubien, who is the minister more praticularly charged with that branch of public affairs, is unavoidably absent from this meeting, as he would, if possible, have taken a deeper interest in the subject under discussion than I do myself. My own department in the government covers the woods and forests, the inland fisheries, and the mines of the Province, and the policy of protection and development which it has been my aim to enforce in the administration of these portions of the Provincial domain is the same policy, I am glad to see, which is to be propounded here in connection with the phosphate industry. There is no doubt that the matter is one of great public importance, for it would be an undoubted benefit to the people of Quebec if our phosphate could be used as a fertilizer in those parts of the Province where, as is well known, the soil is in very great need of having some of its elements restored of which it has been deprived by the cropping of many years.

The question of how phosphate should be applied as a fertilizer is one which I hope will be dsscussed by the gentlemen who are to speak. I have seen it stated that great differences of opinion exist as to whether phosphate can be utilized as a fertilizer without having first been converted into superphosphates by treatment with sulphuric acid, it has been proposed to use simply the crushed phosphate, without any preliminary treatment, but in a report issued under the auspices of the government it is stated that nothing had yet been found to satisfactorily prove the valueof this method. This is a very practical aspect of the question, and as administrator of the Crown Lands Department I should be glad to have some enlightment on the point, with the view of assisting in the promotion of the phosphate industry.

I shall listen, gentlemen, with great pleasure to your deliberations, and I trust that much good will follow from your meeting, not only in the greater diffusion of knowledge and enhanced value of our mines, but in the stimulus which will be given to the agricultural interests of the Province. I may express the hope also that you will be able to combine pleasure with usefulness, and that when you leave the old historical city of Quebec, you will take with you the happiest reminiscences of your sojourn here. (Loud Applause).

The Use of Electrical Apparatus in Mining.

MR. W. F. DEAN—I shall be obliged to omit altogether apparatus operated by battery or magneto currents, such as bells for signalling, telephones, and blasting apparatus, the operation of which is now pretty well understood, and confine myself to electric lighting and the electrical transmission of power, paying more particular attention to such apparatus as is most likely to prove useful to members of this Association.

I wish to take up and explain first of all, several fundamental principles in electric transmission, either for lighting or power, a knowledge of which is necessary to a clear understanding of the subject. The first and most important of these is that for transmitting a certain amount of power at a certain voltage or pressure, with a certain loss in the wire, the cost of copper increases as the square in the distance.

A recent paper by Mr. Irving Hale gives the following example: If for transmitting 100 horse-power one mile at 500 volts, with 10 per cent. loss in line, the wire costs $2,000, it will cost for transmitting the same power two miles, under the same conditions, the square of two or four times $2,000, or $8,000, and for ten miles, one hundred times $2,000, or $200,000. The reverse of this law is that for a certain power distance and loss in line, the cost of wire is inversely proportional to the square of the voltage. For instance, if it costs as explained, above $200,000 for wire to transmit 100 horse-power ten miles with 10 per cent. loss at 500 volts, it will cost at double that voltage or 1,000 volts, one quarter as much or $50,000 and at 5,000 volts (ten times the voltage) one-hundredth as much, or $2,000. Thus the same power can be transmitted with the same loss, ten miles at $5,000 volts, for the same cost of wire that is required for one mile at 500 volts.

When inventors first began to realize the commercial importance of incandescent lighting, one of the most difficult problems was to produce a lamp of sufficiently high voltage to bring down the cost of conductors to a reasonable figure. Edison's discovery of the high resistance filiment solved the problem and made it possible to use a voltage of about 110 for distributing purposes. Even this was found inadequate for large areas and he afterwards devised the three wire system, in which two dynamos are connected in such a manner that while the total voltage of the system is 220, the lamps being connected to a third or neutral wire receive only 110. By this means the voltage is doubled and the cost of copper accordingly reduced to one-fourth, or, practically, taking the central wire into consideration, to not more than three-eighths. This system is in use in nearly all large cities, both on this continent and in Europe. Later, attention was directed to the alternating system, which has been rapidly adopted in cases where the lighting is scattered or where long distances have to be covered. A brief consideration of the properties of alternating currents will show why it is better adapted for this work. If the electro-magnetic impulses that form an electric current are propagated continuously in one direction, the current is said to be continuous, but when they alternate in direction at a more or less rapid rate, then the current is said to be alternating. The alternating current enables us to take advantage of an effect called induction, which is only exerted when the current is suddenly broken or changed in direction. Thus if we wind two separate coils of wire on an iron bar, and pass a direct current through one coil, no effect is produced in the other coil except at the moment of turning on the current, but if an alternating current is used instead, a current is at once produced and maintained in the second coil. By a very simple law the pressure or voltage of the two coils are in proportion to the number of turns in each. Thus if the primary coil is supplied with current of 1,000 volts, and the secondary coil has one-tenth as many turns, the pressure in the secondary will be 100 volts. Such a device is called a transformer, and its use enables us to employ practically any voltage necessary for economy in transmission and reduce it to a low pressure at any desired point for use in lamps or motors.

The alternating current machine may be built to give directly a pressure up to 2,000 or 3,000 volts and in certain types as high as 5,000 volts. If this is insufficient for the purpose, the voltage may be still further increased by the use of transformers described above. By the proper proportion of the primary and secondary coils, the voltage may be raised to any pressure which can be safely transmitted over ærial lines.

Having thus described as briefly as possible the principles of electric transmission, and the different forms of current that may be employed, I will now take up in detail the different uses to which electrical apparatus may be applied:

Electric Lighting—Electric lighting for mines and auxiliary works offers the same advantages that are now so generally recognized as appertaining to this method of illumination for other uses. Its steadiness, freedom from heat, and the ease with which it may be distributed, places it far in advance of any other artificial light. When once installed, the expense of operation is inconsiderable, especially when operated in connection with a complete electrical power system. The type of apparatus will be determined entirely by the conditions in each case. If the distance to which the lights are transmitted is small, a direct current dynamo of 110 volts will be the most satisfactory. In deep mines, however, and in cases where the source of power is at a considerable distance from the workings, the cost of conductors at this pressure becomes prohibitive, and it is necessary to use some method in which the voltage can be increased. By the use of two dynamos connected on the Edison three-wire system previously explained, the cost of conductors can be reduced to about three-eighths the amount required by the two wire-system, assuming that the third wire is made the same size as the outside wires. It is also possible to use a single dynamo of 220 volts, but this has its disadvantages, as it is necessary to use two lamps in series, and any accident to one of a pair puts the other out of use as well. For very long distances the alternating system at 1,000 volts pressure, or higher if necessary, may be used, the voltage being reduced by means of transformers to about 100 volts at the lamps.

Whatever type of dynamo is selected, should be placed in a dry position, free from dust, and if possible an independent foundation of brick or stone should be provided. An endless belt will always give the best results, as lacing produces a momentary flicker in the lights at each revolution. In all cases the steadiness and to some extent the life of the lamps is dependent on uniformity of speed.

The switchboard containing the necessary instruments and controlling devices, is preferable to slate or marble but as the expense of such a board is quite an item, a skeleton frame work of hardwood well shellacked may be made to answer every purpose. From the switchboard the wires are led to the distributing point which should be as nearly as possible in the centre of the district to be lighted. If the work is above ground, the method of installing the lines and lamps will not differ from the usual practice. If, however, the wires are to be carried underground, a much higher insulation must be maintained, and the work must be carried out in every respect with the greatest care.

For all mines where nitric acid does not occur, lead covered cables with rubber insulation are found to be the most suitable. The most satisfactory supports for lead cables are malleable iron brackets, but the method of securing them to the walls or roof must be determined entirely by the situation. On these brackets are placed glass insulators of the deep grove pattern and the cable is in turn secured to these. All cutouts and switches should be placed in malleable iron boxes and the cable should be led into these through hard rubber bushings. No attempt should be made to use key sockets for the lamps. Keyless sockets or porcelain or hard rubber should be used, or special fixtures similar to those designed for marine work. It will always be found to be economy in the long run to use only the highest class of insulation in underground work, and to have all fittings installed in such a manner that the chance of interruption to the service is reduced to a minimum.

Transmission of Power.—I do not know that it is necessary for me to point out the advantages of electrical transmission of power for mining. It is in many cases so self-evident that it requires no demonstration. It is seldom indeed that minerals are found in the most convenient place for their extraction from the earth. The necessary transportation of coal or other fuel makes the cost of operating any machinery excessive, and prevents the use of labor-saving devices which would be adopted if the problem of cheap power were solved. In fact the absolute necessity of obtaining power often forms one of the most serious problems to mining engineers.

Direct current apparatus has for a long time been used for this purpose, and for comparatively short distances has proved itself satisfactory in every way. Motors have been applied to hoists, pumps, diamond drills, air compressors, ore crushers, stamp mills, and almost every form of mining machinery. It was soon found however, that with the direct current, the voltage was limited to about 500 to 800 volts, and at this pressure it was impracticable to cover very long distances. Until a comparatively recent date, the alternating current could not be successfully used for motor work. The only motors available were of the synchronous type, so called because they run at the same speed or in a certain proportion to the speed of the generator. When operated on single phase circuits, they are not self-starting but must be brought up to their normal speed by an independent source of power. The load is then carefully applied by a friction clutch. If the work to be done is for a moment in excess of the capacity of the motor, they get out of step, as it is called, and stop. They also require a separate machine as an exciter to energize the field. It will thus be seen that their use for general power purposes is limited. By the introduction of what is known as the multi-phase systems all difficulties have been overcome and alternating current motors are now manufactured which are equal to the best direct current motors in efficiency and starting torque, and which have the additional advantage of having no commutator or moving contacts of any kind.

The three-phase system, which has so far been more generally adopted than its rival, the two-phase, may be best described as a combination of three separate alternating currents in which the reversal occurs at different times. The result is that the impulses which produce the rotation are at no time entirely interrupted. This system was first used at the Frankfort Electrical Exhibition held during the summer of 1891 in Germany, where the power was transmitted from Lauffen to Frankfort, a distance of 112 miles.

One of the first plants installed on this side of the Atlantic was at Hartford, Connecticut, which has been in operation since November, 1892. The machines in use here are of about 400 horse-power capacity, one being used as a generator and the other as a motor. The motor is used to drive street railway generators. Both are wound for low voltage, the pressure being raised at the generator end to 7,000 volts, and transmitted over the line, which is eleven miles in length, at this voltage. It is then reduced by means of transformers to the same potential as at the generator.

Following the Hartford plant, the plant at Redlands, California, was installed. This installation is a typical one for general central station work and supplies motors and arc and incandescent lamps. It was started on September 7th, 1893. After this practical start the adoption of the system was rapid both in the west and in east, some of the principal plants now in operation or under contract being at Taftville, near Norwich, Conn.; Concord, N.H.; Columbia, S.C.; Portland, Oregon; Santa Rosalie, Mexico; Sacramento, Cal.; Pelzer, S.C.; Park City, Utah; Pachuca, Mex.; Silverton, Col.; Troverse City, Mich.; Norway, Me.; Gouverneur, N.Y.; Rochester, N.H.; Bel Air, Maryland; Austin, Texas; St. Hyacinthe, P.Q.; Dowagiac, Mich.; Sparta, Wis., and East Poland, Me.

Of these the plants at Santa Rosalie and Pachuca, Mex., Park City, Utah, and Silverton, Col., are exclusively for mining purposes. The Pachuca installation is the largest of these and offers a typical example of a three-phase transmission plant on a large scale. At the generating station are placed five three-phase alternators of 400 horse-power each, directly coupled to a Pelton water-wheel operating under a head of 700 feet. These machines generate current at a comparatively low potential of 700 volts. This current is led to transformers wound for a ratio of 1 to 15, thus raising the pressure to 10,500 volts. The line, which consists of three wires, No. O, B and S gauge, extends first to Real del Monte, a distance of 67,400 feet, or a little less than thirteen miles. Here is situated a transformer sub-station where the potential is reduced to 2,000 and 500 volts. The current at 500 volts is used to operate the machinery for two mines in the immediate neighborhood, while the 2,000 volt current is led to the Escobar and Barron mines, a distance of 4,400 and 11,000 feet respectively. The high potential line is then continued to Pachuca, a distance of 21,600 feet, where another sub-station is located supplying current through transformers to five mines in that vicinity. A third sub-station is located at San Rafael, 15,840 feet farther on, the total distance from the source of power being over twenty miles. It is expected that enormous economies will be effected by this plant over the old system of operating machinery by coal.

At Silverton, Col., we have definite data as to the saving affected by power transmission.

In Mr. Irving Hale's paper describing this plant, which has a total capacity of 400 horse-power, he states that the saving will not be less than $36,000 per year. The distance in this case is about three miles.

Aside from the direct saving effected by the use of electric power, which in many cases is sufficient to more than pay for the plant the first year, it is often found that the greater ease of operation and small repair account still further increase the balance in favor of electricity. Electric motors offer advantages over other forms of power for almost every description of mining work.

Electric Hoists.—To hoisting, for example, the motor is peculiarly applicable. A hoist does its heaviest work in starting its load. A steam hoist having two engines with cranks at right angles can only be depended upon at this time for one-half of its rated capacity as one of the engines may be on a dead centre. An electric motor, on the other hand, has no dead centres, and a heavy current in excess of the normal, can be turned into the armature for a few moments without danger.

This important advantage is of great value, and gives electric hoists a greater capacity, other things being equal, than a steam hoist. The simplicity, too, is very apparent; instead of two link motions, we have a simple reversing switch, and the only parts subject to wear in the motor are the two bearings and the commutator. In the alternating motor the commutator is eliminated, giving an ideally simple motive power.

Electric Pumping.—The advantages of electrically operated pumps may be summed up briefly as follows. Saving of room as compared with Cornish pumps or other systems requiring a separate pump-shaft. The possibility of placing them in the most advantageous situation and connecting them to the sources of power, without heavy expense. Ease of control from a distance and independently of each other. The type of pump best adapted to electric driving is the triplex, which gives an even resistance to the rotary motion of the motor. They are built in almost every form required in mining operations. Centrifugal or rotary pumps are also well adapted to electric driving, and may be used where it is only required to raise the water to moderate heights.

Electric Haulage.—Remarkable successful results have been obtained in the application of electric haulage to mines, and it is now recognized as the ideal system for handling mine products. The first cost is somewhat more than a rope haulage plant, but the cost of maintenance and repairs is considerably less. Any locomotive system is more flexible than rope haulage, as the lines can be easily changed or extended. The construction of the electric locomotive admits of adapting it to the local peculiarities of the mine, and may be made for very low entries and for little or no overhang beyond the rails. Where the service required is simply the transportation of ore or materials on the surface, a standard street railway truck may be equipped with any particular type of car body required for the work. This may be used to tow a number of trail cars if necessary. Where it is desired to handle standard railway cars without a second handling of the material. locomotives of different capacities have been designed.

Electric Drills.—I am aware that electric percussion drills are not as a rule very well thought of by mining engineers in this country. They were originally placed upon the market without proper tests and before they had been perfected as a commercial piece of apparatus. Extravagant claims were made for them and the results were for this reason all the more disappointing. For the past two years the company with which I am connected has been engaged in perfecting the electric percussion drill, and their satisfactory working, wherever placed, is the best proof of our success. No change has been made in the principle of the drill. The iron plunger is given a reciprocating motion by two electro-magnets in the drill body, to which a pulsating current is supplied by a specially designed generator. The mountings are in every respect the same as the standard air or steam drill. The improvements made have been in reducing the heating of the coils and in devising an insulation which could not be injured by rough usage which a rock drill is called upon to withstand. While this may seem a small matter it pratically makes the difference between an experimental piece of apparatus and a commercial tool.

Electric drills offer peculiar advantages when the location of the work is often changed or where the source of power is at a considerable distance. They are more efficient and operate with less loss in transmission than steam or air drill. In place of expensive and troublesome pipe lines, a flexible cable easily changed in position is all that is required.

Miscellaneous Power Work.—In addition to the uses mentioned, electric motors may be applied to almost any form of mining machinery, the problem of their application being a mechanical rather than an electrical one. Special uses in connection with his own work will doubtless occur to any practical mining engineer. One object of this paper has been particularly to point out the great advance which has been made in transmitting power over long distances. What can now be easily accomplished in this respect would have been difficult, if not impossible, even so recently as two or three years ago, and it is of the greatest importance that mine operators, using any considerable amount of power, should carefully investigate this matter. The saving of a large part of the expenditure for fuel would mean in many cases increased dividends, and in some cases would doubtless bring the balance of profit and loss account to the credit instead of the debit side.

MR. JOHN BLUE—The valuable paper which has just been read is one that ought to be discussed, but it is also one that few ordinary mining men are able to discuss on short notice. I think the best thing we can do is to study Mr. Dean's paper when it appears in THE MINING REVIEW, and be prepared to discuss it at our next meeting.

MR. R. H. BROWN—I have had no experience at all with electricity, but I may say that whenever we have asked for tenders for the construction of such things as hauling and dumping plants, we have always found electrical apparatus the most expensive. I was mentioning this fact to Mr. Dean, and he tells me that of late the cost has been lessened very much; but at least two years ago the price was prohibitive as compared with either steam or compressed air.

MR. DEAN—The advance has been particularly in the transmission of power through long distances by alternating currents. These can be produced as cheaply as continuous currents, and they have the advantage of being entirely sparkless, a point which I did not mention in my paper. With proper precautions they can be even utilized in a mine where explosive gases occur.

Phosphate's Future.

By Robert C. Adams, Montreal.

The apparent extinction of the Canadian phosphate industry has led many to regard it as dead and buried, beyond any hope of resurrection. A consideration of some facts and circumstances may warrant the hope that the mining of apatite will again revive, and that it will yet assume the prominent position in Canada's production that it was once expected to fill.

The principal causes of the decline of the industry were,

1. The fall in prices, due to increased production in other countries, notably in Florida, and also to the general depression of the agricultural interests.

2. The high cost of apatite mining owing to the uncertainty of its occurrence, and the expense of selecting or "cobbing" it.

3. The loss in weight and the frequent rejection of shipments that failed to analyze up to the guaranteed quality.

4, The lack of a home market.

As to the first cause, the fall of prices,—two remedies are already in sight. Phosphate producers the world over have been impoverished by the low prices, and are either lessening their output, or are combining to secure higher figures. The increasing value of agricultural products will bring prosperity to the farmer and naturally lead to a larger demand for fertilizers and better prices. It is quite reasonable to expect a considerable advance in the price of phosphates in the near future.

Secondly.—Although apatite cannot be expected to occur in more favorable modes than it has done in the past, it is better understood and there will not be the wild waste of money in fruitless search under improbable chances of success Mchanical and chemical means of separation may lessen the expense of cobbing and secure a more uniform quality. Methods have been patented by which the phosphoric acid s taken into solution from the pulverized rock and is then precipitated ; a process which if successful would make a vast saving in the labor of selection and the cost of transportation, as only the pure product need be shipped. Mechanical separation by specific gravity has met with some success ; and a combined chemical and mechanical process may be found to be available, as it is said that fluids can be compounded having a specific gravity of 3·5, which would float away all lighter substances. As the specific gravity of apatite is 3·2 jigging in two fluids, one under and one over its gravity, might secure an effective separation. These facts skilled experts must determine.

Thirdly.—By grinding all the phosphate and shipping it in bags and barrels there would be less loss in weight and more accuracy in sampling for the determination of quality.

Fourthly.—As to the home market, there is a certainty that it must arise. Agriculture is the basis of a country's prosperity and fertilizers are the basis of agriculture. It is estimated that every year a million and a half tons of phosphate are taken out of the soil of the United States by its food crops. Every net ton of wheat contains about 16 lbs. of phosphoric acid, and the average soil contains about 68·6 lbs. to the acre or just enough to supply the phosphate to 4·16 tons of wheat. In process of time the fertility of the soil is exhausted unless the ingredients that have been extracted by the crop are returned to it. A complete fertilizer is said to be composed of phosphate, potash, and ammonia, but the greatest of these is phosphate. Vast areas of land in eastern Canada that were formerly rich producers of grain are now barren, for lack of being supplied with plant food. A judicious use of fertilizers would restore vitality to the soil. The worn-out cotton lands of Georgia, by the use of artificial manures, were raised in twenty years from a value of $3 per acre to $30 per acre. The same transformation might take place in Quebec could knowledge and enterprize be combined to apply the remedy. Every ton of phosphate that can be produced in Canada is needed on her own soil, and should be sold for use here instead of being transported thousands of miles and often sacrificed in competition with inferior foreign products, or through losses by those tricks of trade that are so notable a feature of modern commerce.

A few years ago, after Col. North and others had made immense fortunes in nitrate, a writer in the London Times, in an article upon phosphate as a fertilizer, said : "To adopt a homely simile, the nitrate is like a glass of spirits, while the phosphate may be compared to a plate of beef." This caught the British fancy and did a good deal to stimulate investment in Canadian phosphate lands on the part of some who thought that, to follow out the simile, phosphate kings might become as much richer than nitrate kings as beef was superior to spirits. Under this stimulus extravagant prices were paid for lands, and rash and unwise methods of operation were attempted, all of which contributed with the falling market to the ruin of the industry. But the fact remains that phosphate is the most valuable plant food that is known. The lands of the settled portion of eastern Canada are exhausted and phosphate is the principal tonic needed to restore their vitality. The use of phosphate constantly increases throughout the world. England and Germany are using ever-enlarging quantities, and in the United States every year more than a million tons of fertilizers are made, of which phosphate is the chief ingredient.

How shall this home market be created ? The first means is the education of the farmers. The distribution of a knowledge of the results obtained by the careful tests made at the experimental farms would tend to give confidence in the use of such fertilizers as were recommended. The agricultural societies should be encouraged to spread information and help experiment. Missionaries should be sent to the waste places to preach the gospel of fertilization by which the wilderness may rejoice and blossom as the rose. The Government may rightfully engage in this work of enlightenment.

A difference of opinion exists as to whether it is a correct policy for the Government to give direct pecuniary encouragement to industries. The majority of the people have decided in favor of a national policy, which has enabled anyone who manufactured any article, be it pickles or pig-iron, to go to Ottawa and secure either a protective duty or a bonus, or both. If this is the policy of the country, surely it can in no case be so well applied as in the promotion of agriculture, the staple industry of the land, upon which its prosperity mainly rests. While there are about 300,000 people in the Dominion engaged in mechanical and manufacturing industries there are nearly 800,000 occupied in production from the soil. The occupiers of land number 620,486 of whom 524,806 are owners and only 92,708 are tenants. So large a land-owning class implies the intelligence essential to successful cultivation of the soil, and there can be no more hopeful field for the inculcation of useful practical knowledge pertaining directly to the welfare of the people, than among the sturdy agriculturists of Canada. As long as the Government see fit to bonus or protect industries employing a few hundred workers, the 600,000 farmers of Canada have a right to ask for consideration, and in no way can they be aided to prosperity better than by assistance to the intelligent use of cheap and effective fertilizers. If the Government would devote a sum of money to the spread of knowledge about fertilizers, and to the encouragement of the mining and manufacturing of phosphates, it would be of greater benefit to the country than the same amount of money applied to any other industrial pursuit, be it what it may. There is no proper conception as yet in Canada as to the great value to be obtained from the judicious use of artificial fertilizers, and if the Government is to be in any sense paternal it should consider its primary duty to be to increase the productiveness of the soil.

By the establishment of fertilizer manufactories and the consequent creation of a home market for phosphate, a great stimulus would be given to the cheap production of apatite. Many farmers have deposits of phosphate upon their lands or in their neighborhood. They are often willing to put in their spare time in winter in mining, even if it only yielded them wages of 50 cents a day. In the early period of phosphate mining in Canada a large output was obtained from this source, but the difficulties of foreign shipment, or unsatisfactory dealings with middlemen, discouraged these efforts. With a ready market at hand for small quantities, a great many people would turn their attention to the mining of apatite, even at the present low prices, and this work in some cases would certainly lead to the discovery of large deposits that would pay handsome profits. Although the average cost of phosphate may be said to be $8 or $10 a ton, it has often been the case that a bunch of 100 tons has been taken out at a cost of not over $2 a ton. The fortunate farmer who should strike this bonanza would make more profit from it in one month than the other products of his farm would yield him in a year. This success would stimulate others to work and thus enlarge the output.

One favorable feature in the future prospects for Canadian phosphate mining and fertilizer manufacturing is the facility for cheap freights to the far west. It is a remarkable fact that nearly all the phosphate mines of Canada are so situated that their products can be water-borne to market with only a short land haulage. The Lievre, Gatineau, and Ottawa rivers, and the Rideau canal can float the mineral to the St. Lawrence at either Montreal or Kingston, from whence the returning grain barges and schooners would transport it to the west at almost ballast rates of freight. The phosphates of Carolina or Florida to reach the same points along the shores of the great lakes must pay freight rates to the railroads greatly in excess of the rates by the water route. This saving added to the superior value of Canadian apatite might overcome the competition due to cheapness of production at the south, and as the use of fertilizers extends in the west as it is bound to do, Canada may become the chief source of supply for that great region which for a thousand miles adjoins the Canadian waterways.

One of the greatest means of increasing the production of phosphate would be to prove that in its crude state, finely ground, it is effective as a fertilizer. At present the custom is to mix the phosphate with an equal weight of sulphuric acid, by which means it becomes soluble in water and is termed superphosphate. It is due to the acid that the objectionable odor exists. This process increases the cost of the fertilizer to the farmer two or three-fold. Many experiments go to show that the raw phosphate is effective, especially when mixed with stable manure, or when applied to crops that do not require a very quick stimulant. Mr. W. H. Bowker, the eminent fertilizer manufacturer, while arguing for the general superiority of superphosphates, says: "There may be places where insoluble phosphates can be advantageously applied, as upon land covered with fruit trees or devoted to grass. Perennial plants, like grasses and trees, no doubt extract phosphoric acid more readily than annual plants, owing to their numerous and well-developed roots. Winter grains, especially wheat, from the long time it occupies the ground, and its growth in the fall, may also be benefitted by an insoluble or partially insoluble phosphate." As this admission applies to four-fifths of the cultivated land, it indicates the possibility of an extended use of crude pulverized phosphate.

Another reason for expecting a revival of Canadian apatite mining is the fact that in a great many instances it is associated with phlogopite,—mica of amber or silver-grey color. This mica was formerly worthless, and many phosphate pits were abandoned on account of the prevalence of this mineral. Now that its use as an electrical insulator has become general, selected lots of mica can be sold for $100 a ton, and many properties which would not pay if worked for phosphate alone, or for mica alone, may be made profitable by the production of the allied apatite and mica.

Our reasons for hopefulness as to a revival of the Canadian phosphate industry are based, then, upon the expectation of a rise in prices ; better systems of mining and selection ; shipping in the pulverized condition ; the opening of a home market ; the availability of the great western market by means of cheap water freights ; the increasing use of phosphate everywhere ; the certainty that phosphate of lime is the best fertilizer known ; the assurance that Canadian apatite is the richest known available source of phosphoric acid ; the efforts already made by Government, through the experimental farms, and by agricultural societies to gain knowledge of plant food ; the hope that more effort will be made to spread this knowledge ; the hope that the Government may find effective means to encourage the industry ; the use of pulverized phosphate as a fertilizer, thus securing a very cheap article, in which the buyer might feel more confidence than in a mysteriously manufactured article chiefly remarkable for its bad smell ; and finally the possibility of mining, with the phosphate, mica as a by-product and getting two results for one effort. Added to all these is a sentiment that in these days of altruistic development may not be altogether unworthy of consideration by a body of men so noted for humane ideas, and for a devotion to ethical culture as are the mining men of Canada.

All men want to make money ! Most men care not how they make money ! Some men want to moke money in useful ways. The latter are not content to gain their profits by ministering to the luxury, folly, or vice of mankind, they have the philanthropic sentiment as well as the greed for gain. They do not wish to thrive by selling silks, wines, jewellery, rum, tobacco, patent medicines, or lottery tickets. They prefer to deal in coal, iron, grain, cattle, and the common necessaries of life, and they desire to have the sentiment of rendering real service to their fellow-men, while they are at the same time earning their livelihood or gaining a fortune. The production and manufacture of fertilizers gives a field for operation that for beneficence cannot be surpassed, and in other countries these industries have proved to be the source of large fortunes.

There is an oft quoted passage of Dean Swift's in Gulliver's Travels which is worth repeating in this connection : "And he gave it for his opinion that whoever could make two ears of corn or two blades of grass to grow upon a spot of ground where only one grew before, would deserve better of mankind and do more essential service to his country than the whole race of politicians put together." This idea should encourage capitalists with humane sentiments or corporations with souls, if any such exist contrary to proverbial slander, and they surely do, to engage in this useful occupation of the production of fertilizers. Whatever may be said as to the scent which they give to the air they are unsurpassed among manufactured products in the odor of morality and the flavor of beneficence.

In view of all these physicial facts and moral influences may we not encourage hope for the future of phosphate ?

Mr. F. T. Shutt—You remarked, Mr. Chairman, that it was the duty of the government to protect our home industries. What I should like us as a people to realize is that in addition to our mines and our timber we have another resource that it is necessary we should protect—the native fertility of our soils. (Hear, hear.) It is with this view that I have prepared my own paper. In connection with the paper that has just been read, I should like to say that we must not view phosphoric acid, or any other fertilizer, as a tonic or stimulant. I would emphasize the fact that it is plant food. The opinion prevails among our farmers that artificial fertilizers act as stimulants ; that after their use there comes a reaction, and that they have a tendency to exhaust the soil. The fact is quite the contrary. Fertilizers are essentially food for vegetation, and add to, not detract from, the fertility of the soil. Capt. Adams, I think, referred to a chemical means of separating high-grade from low-grade phosphate. I can understand the mechanical method, but I know of no chemical one. I should like to have information on that point.

MR. J. BURLEY SMITH—That is the difficulty which has practically floored us. Chemists do not as yet know of any method of doing it. I have spent considerable time in inventing mechanical means of separation, and have been to a certain extent successful, but I am not aware of any chemical means.

MR. JOHN BLUE—Capt. Adams mentioned that on account of the differcnce between the specific gravity of the gangue and the phosphate it was possible to effeet a separation by means of jigging. In that I think he is wrong, as the difference in specific gravity is altogether too slight.

Phosphoric Acid in Agriculture.

By FRANK T. SHUTT, M.A., F.I.C., F.C.S., Chief Chemist, Dominion Experimental Farms.

When the achievements of science during the present century comc to be written up, I am firmly of the belief that, notwithstanding the useful and brilliant discoveries in electricity and physiology, and the marvellous engineering feats of the age, it will be found that chemistry has, during the past ninety years, contributed more towards the necessaries and luxuries of life, more towards the economy and comfort of living, the civilization and progress of the world, than any other science, natural or physical. Agriculture is the oldest of the arts, but it is only within the most recent time that she has been exalted to a science. The science of agriculture dates from the day when the art of farming becamc to be studied from a chemical standpoint, and chemists sought by analysis to learn the composition of plants and animals, to understand the nature and sources of plant food and animal requirements, and to comprehend the manifold changes that matter undergoes when those changes are brought about by plant and animal life. That day is in the recollection of some that are still living.

Deeply interesting as the history of the birth and development of agricultural science is, it is not my purpose to consider it to-day, even in outline. I shall rather content myself by stating one or two of the fundamental truths of agricultural science, for the knowledge of which we have to thank chemistry. Their realization may help us to understand more clearly the question we are to consider to-day—Phosphoric Acid in Agriculture.

First, then, chemistry has established the fact that plants require food for the maintenance of their life, development and reproduction. Their increase in weight is due to the assimilation of food materials. The assimilation being the result of the exercise of certain vital functions.

Secondly, it has been ascertained that this food is obtained by plants (which, of course, include all farm crops), partly from the atmosphere and partly from the soil. With respect to the former, nature always supplies an abundant quantity; but of the latter—the soil-derived food—the intelligent farmer must see to it that his crops are furnished with liberal amounts in available forms. Fertile virgin soils are storehouses or banks in which are laid up vast supplies of material to be converted by the agency of vegetable life into valuable food products for man and beast. Such stores, however, are not inexhaustible. Every crop harvested must necessarily lessen the amount of plant food in the soil. Science affirms, and practice corroborates the statement, that the continuous harvesting and selling of farm crops without any concomitant return of those elements extracted by the roots of the crops, invariably and inevitably lead to diminished yields, and finally to soil exhaustion of such an extreme character that farming is no longer profitable. Chemistry, then, in agriculture, forces home this truth, "Ex nihilo nihil fit."

Science and practice have shown that of the soil-derived elements of plant food it is generally necessary to replace only three in order that fertility may be maintained. The other constituents, though equally indispensible, are usually present in sufficient quantities in the soil for ordinary farm crop requirements. The three constituents here referred to arc: Nitrogen, phosphoric acid and potash, and are known as the "essential elements of fertility." Manures and fertilizers are, therefore, plant food suppliers, and receive their value primarily, according to the amounts of these essential constituents that they contain. Their chief function is, therefore, to furnish available nitrogen, phosphoric acid and potash in the soil. These elements of plant food have been named in thc order of their commercial value and agricultural importance.

To speak briefly of nitrogen, we have to chronicle most valuable assistance rendered by chemistry to agriculture in the recent discovery that the legumes have the power of appropriating and assimilating the free and uncombined nitrogen of the atmosphere. The leguminosæ include clover, pease, beans, vetches, &c., and as far as is at present known, are the only plants that have this important and valuable power. It would be foreign to our subject to discuss how this assimilation takes place; but I may be allowed to point out that the more extensive growing and feeding of leguminosæ upon Canadian farms will prove the cheapest and most permanent method of enriching impoverished soils in that very important element, nitrogen.

Concerning potash, it is only my purpose to mention that we have in Canadian wood ashes a valuable home source of this constituent. We, as an agricultural people, have not yet come to the realization of the fact that in selling our wood ashes across the line we are parting with a birthright for a mess of potage. Our supply of wood ashes is rapidly diminishing, and the day is not far distant when we shall have to replace the potash so lost to our soils by the salts from the Stassfort mines.

THE OCCURRENCE OF PHOSPHORIC ACID IN NATURE.

It might well be argued that since phosphoric acid is essential to the life of plants, and since vegetable lifc is so widespread, the presence of this constituent in the soil is wellnigh of universal occurrence. Phosphoric acid, chiefly as phosphate of lime, is found in many rocks, in feldspar, granite, gneiss, syenite, trachyte, dolerite, diorite, dolomite, &c., the percentage running from .09 to 1.7. The disintegration and decomposition of rock materials are among the chief factors in the formation of soils. It is thus that the mineral basis of soils are obtained; and hence, it is a very simple matter to account for the presence in them of phosphoric acid. The older rocks, it has been shown, are richer in this constituent than those of later origin. Knowing, therefore, the character of the originating rocks, we are able to form an estimate of the soil's richness in this element.

THE PERCENTAGE OF PHOSPHORIC ACID IN SOILS.

Most authors quote two-tenths of one per cent. as the average amount of phosphoric acid found in a good fertile soil. They further state that one-half that amount probably represents phosphoric acid in soils of ordinary fertility, while very rich and exceptional soils possess from .3 to .5 per cent.

The subjoined table gives the percentage of phosphoric acid in 40 surface soils and 16 sub-soils, obtained in the various provinces of Canada as indicated.

PHOSPHORIC ACID IN CANADIAN VIRGIN SOILS.

No.	PROVINCE.	LOCALITY.	Surface or Subsoil	Character of Soil.	Per Cent. of Phos. Acid.
1	British Columbia..	Ladner's Landing....	Surface..	Alluvial loam........	·27
2	do	Chilliwack..........	Subsoil..	Heavy clay..........	·13
3	do	Squamish Valley.....	Surface..	Sandy loam..........	·20
4	do	Alberni............	do ..	Clay loam	·08
5	do	1st Bench, Ex. Farm, Agassiz............	do .	Clay and sand........	·23
6	do	2nd do do	do ..	do	·13
7	do	Orchard, do	do ..	do	·18
8	do	do do	do .	do	·25
9	do	Pitt Meadows........	do ..	Alluvial loam........	·48
10	do	do	Subsoil..	Yellow sandy........	·13
11	N. W. T........	Walsh Flats..........	Surface..	Clay loams..........	·17
12	do	do	do ..	do	·16
13	do	Tilley..............	do ..	Sandy...............	·13
14	do	do	do ..	Sandy...............	·17
15	do	Vermillion Hills.....	do ..	Undecomp'd rock mat.	·16
16	do	do	do ..	do do	·18
17	do	Yorkton	do .	Black sandy loam.....	·20
18	do	do	Subsoil..	do do	·09
19	do	Calgary..............	Surface..	....	·17
20	do	Saskatoon...........	Subsoil..	Clay................	·10
21	do	Tp. 22, R. 26, W 2...	do ..	Calcareous clay.......	·12
22	do	2 & 3, 34, 35, Tp. 29, R. 24, W. 2.......	do .	do	·11
23	Manitoba........	Sec. 31, Tp. 4, R 1 W	Surface..	Dp. blk l'm vir. pra. s'l	·27
24	Ontario........	Muskoka...........	do ..	Loose sandy loam.....	·26
25	do	do	do ..	Sandy loam..........	·10
26	do	do	Subsoil..	do	·17
27	do	do	Surface..	Light grey sandy loam.	·17
28	do	do	Subsoil..	....	·08
29	do	Russell..............	Surface..	Grey sandy loam......	·21
30	do	do	Subsoil..	Light yellow sandy....	·10
31	do	do	Surface..	Grey sandy loam......	·09
32	do	Walkerville..........	do ..	....	·12
33	do	Muskoka...........	do .	Sandy and light	·17
34	do	do	Subsoil..	do	·17
35	do	Port Arthur........	Surface..	Grey red sandy loam..	·14
36	do	Lot 14, Con. 10, Brunel Tp., Muskoka......	do ..	Clay loam...........	·16
37	do	Muskoka............	Subsoil..	....	·09
38	Quebec..........	Arthabaska	Surface..	Sandy loam..........	·16
39	do	do	Subsoil..	....	·17
40	do	do	Surface..	Black muck..........	·22
41	do	do	Subsoil..	Grey sandy..........	·31
42	do	St. Adelaide de Pabos.	Surface..	Red sandy..........	·04
43	do	do do	do .	do	·07
44	do	St. Clet............	do ..	Dark grey sandy loam.	·32
45	do	do	Subsoil..		·29
46	do	St. Ignace du Nominin-	Surface..	Heavy clay loam......	·18
47	do	do do [que	Subsoil..	do do	·18
48	do	St. Peter Joliet.......	Surface..	Black clay loam	·27
49	do	do	Subsoil..	....	·28
50	do	Maria, Bonaventure...	Surface..	Yellow soil..........	·18
51	New Brunswick..	Restigouche.........	do ..	Pale yellow soil	·08
52	do	Sackville Marsh......	do ..	....	·15
53	do	do	do ..	....	·17
54	Nova Scotia....	Cumberland	do ..	Sandy	·06
55	do	S. W. Mabou	do .	do	·09
56	P. E. I..........	Kings Co............	do ..	Light sandy loam.....	·09

These results have been collated from the annual reports of the Chemical Division of the Experimental Farm, in which may be found the complete analyses of the soils, as made in our laboratory at Ottawa.

The samples examined by no means represent the "Provincial character" of the soils; that would be impossible with such a limited number of examples. They are, however, fairly representative of tolerably large areas of uncropped and unmanured lands in the various provinces.

The percentages above recorded may be regarded as those of "total" phosphoric acid; being determined after treatment of the soils with hydrochloric acid, according to the method as suggested by the Association of Official Agricultural Chemists of the United States. I shall not discuss these data in detail, but attention may be called to the high phosphoric acid content in the soils of alluvial origin from British Columbia, and in the virgin prairie soils of Manitoba. We obtain as an average of the above table. the following percentage of phosphoric acid:—

Surface soils (40).................................... .17
Subsoils (16)... .15

Assuming the weight of the surface soil to a depth of nine inches over one acre to be 2,600,000 pounds, we find an average amount in that area of 4,420 pounds of phosphoric acid. In the surface soils of alluvial and prairie origin, the amount of phosphoric acid would be still larger, more especially when we consider the greater depth of these soils.

CONDITION OF PHOSPHORIC ACID IN SOILS.

The natural phosphoric acid of the soil does not exist for the most part in a condition available for plant use. It is there present as the phosphates of lime, iron and alumina—compounds practically insoluble in water.

While, therefore, we have in ordinary soil analyses data regarding what may be termed the "total richness" in phosphoric acid, such analytical data, as usually obtained, do not furnish us with information respecting the availability of that phoshoric acid for plant use. Plants require their food in a soluble condition or in one that they can render such by the acid exudation of their roots. Hence the fertility of a soil cannot be measured entirely by the totals of its constiuents. Thus, as has been pointed out, many farm soils containing an amount of total phosphoric acid equivalent to two tons or more per acre, have had their yields vastly increased by the application of 2 or 3 hundredweights of superphosphates containing, say, from 30 to 50 pounds of soluble phosphoric acid.

The following table gives the weight of phosphoric acid taken from the soil by farm crops per acre. The amounts stated have been calculated from reliable chemical data and computed average provincial yields. With good farming the yields here quoted would be from one-third to two-thirds greater :—

WEIGHT OF PHOSPHORIC ACID TAKEN FROM THE SOIL BY FARM CROPS PER ACRE—AVERAGE.

	Pounds.
Wheat, 20 bushels, grain—Grain and straw	15.7
Barley, 25 bushels, grain—Grain and straw	14.0
Oats, 35 bushels grain—Grain and straw	15.6
Corn fodder, glazing—11 tons	32.5
Timothy and clover—One and a-half tons dry	15.0
Turnips (10½ tons of roots)—Roots and tops	27.3
Mangels (10 tons roots)—Roots and tops	28.0
Carrots (8½ tons roots)—Roots and tops	21.8
Potatoes (3 tons tubers)—Tubers and haulm	14.5

We thus see that the average annual phosphoric acid requirements for farm crops is somewhere in the neighborhood of 20 pounds per acre. We might, therefore, infer—providing the natural phosphoric acid of the soil were even in a fair degree available—that an addition of superphosphate would be unnecessary and unprofitable. Such, however, as already stated, is not the case. The explanation is, that the phosphoric acid of the soil, although frequently present, as regards amount, in ample quantity for crop use, becomes but very slowly available. This latter process is brought about by the solvent action of the soil water containing carbonic acid and the solvent action of the acid sap in the plant rootlets. I repeat, therefore, that soil fertility is dependent rather upon the percentage of available plant food than upon its total percentage. Soil exhaustion is principally the loss, by rapid succession of crops, of the store of immediately available elements in the soil. Our purpose in manuring is to replace them there in such conditions that they may at once be made use of by plants.

SOLUBILITY OF PHOSPHATES.

With respect to the solubility of mineral phosphate in soil water, Warrington says: "One part of pure tricalcic phosphate dissolves in 6,788 parts of water, saturated with carbonic acid." Some experiments made in our laboratory at Ottawa, on the solubility of the finely ground phosphates, resulted in showing that phosphoric acid equivalent to .05% of tricalcic phosphate had been rendered soluble when 5 grammes were treated for 3 hours with 150 c. c. of water through which carbonic acid was kept bubbling. Previous calcination of the ground phosphate increased its solubility when treated as in the foregoing experiment. In one trial, phosphoric acid equivalent to .45 per cent. of tricalcic phosphate had passed into solution. From these data it is evident that neither the particles of phosphate rock originally present in the soil nor as added in the form of ground apatite, can furnish, *per se*, at any one time, more than very small quantities of available phosphoric acid.

We may now inquire as to the solubility of the soil phosphoric acid in the sap exudation of rootlets, since it is by this means that plants are largely able to appropriate the mineral matter of the soil. Dr. Bernard Dyer, in a paper on the available mineral plant foods in soils, published in the journal of the Chemical Society, England, March, 1894, gives, among many other interesting data respecting the condition and amounts of plant food in soils, the results of his lengthy investigations to determine the degree of acidity of root sap. Dr. Dyer examined a large number of agricultural and garden crops, taken during the season of active growth. He made in all about 100 determinations, examining representatives of 20 natural orders of plants. His method of procedure I need not here explain, but his conclusion is of the greatest import. The average "sap acidity" for the roots of the 20 orders is .91 per cent., expressed as crystallized citric acid. Dr. Dyer concludes that these determinations "appear to be sufficient to indicate that the ratio of the soluble free acid in the roots of plants and the moisture contained in them—which is here called sap acidity—probably generally falls within, and not very far within, one per cent. crystallized citric acid." Citric acid was chosen by Dr. Dyer "partly on account of it being an organic acid, and in the sense contrary to other root sap acids, and partly because it is the acid generally used by those who have attempted to determine available phosphoric acid in manures by means of weak acids."

Dr. Dyer then proceeded to determine the amount of mineral plant food in the soil soluble in one per cent. citric acid solution, and by this means obtained a knowledge, more or less accurate, of the quantities of the phosphoric acid and potash—which quantities would represent the "immediate fertility" of the soil. The determinations were made on samples from the celebrated experimental farm of Sir John Lawes (at Rothamsted, England), with whom for over fifty years Sir Henry Gilbert has been associated in original agricultural research. For forty years in succession barley had been grown upon the plots from which the soils were taken. An exact account of its yields in straw and grain, as well as of the fertilizing constituents applied, has been kept. In all, 22 samples of soil were examined. The results are of such intense interest that I shall insert Dr. Dyer's table of results :—

PHOSPHORIC ACID DETERMINATIONS IN SAMPLES OF BARLEY SOILS FROM HOOSFIELD, ROTHAMSTED.

MANURE APPLIED EVERY YEAR SINCE 1852 (for quantities see pages 143 and 144).	Percentage of Sulphuric Acid in Fine Soil, calculated on Dry State.			
	Total Phosphoric Acid.	Phosphoric Acid dissolved by 1 per cent. solution of Citric Acid.	Total Phosphoric Acid.	Phosphoric Acid soluble in 1 per cent. solution of Citric Acid.
			Lbs. per Acre.	Lbs. per Acre.
1. O. No manure	0.099	0.0055	2503	139
2. O. Superphosphate	0.182	0.0463	4601	1170
3. O. Potash, &c., (no phosphates)	0.121	0.0100	3059	253
4. O. Superphosphates, potash, &c.	0.189	0.0538	4778	1360
1. A. Ammonia salts	0.097	0.0060	2452	152
2. A. do and superphosphate	0.173	0.0425	4373	1073
3. A. do and potash, &c. (no phosphate)	0.102	0.0081	2579	205
4. A. do superphosphate and potash, &c	0.182	0.0500	4602	1264
1. AA. Nitrate of soda	0.104	0.0067	2629	170
2. AA. do and superphosphate	0 165	0.0350	4171	909
3. AA. do and potash, &c. (no phosphates)	0.104	0.0082	2629	207
4. AA. do superphosphate and potash, &c	0.179	0.0475	4525	1201
1. AAS. Nitrate of soda and silicate of soda	0.106	0.0071	2680	180
2. AAS. do do do and superphosphate	0.180	0.0475	4550	1201
3. AAS. do do do and potash, &c. (no phosphates)	0.105	0.0112	2654	283
4. AAS. do do do superphosphate and potash, &c	0.169	0.0479	4272	1211
1. C. Rape cake	0.158	0.0187	3731	442
2. C. do and superphosphate	0.229	0.0636	5408	1503
3. C. do and potash, &c. (no phosphates)	0.152	0.0214	3590	505
4. C. do superphosphate and potash, &c	0.203	0.0563	4794	1330
7¹. Farm yard manure for 20 years, unmanured for last 18 years	0.134	0.0206	3332	512
7². Farm yard manure for 38 years	0.176	0.0447	3669	932

These figures are very significant as pointing out the comparatively small amount of available phosphoric acid to the total amount present. As remarked by Dr. Dyer, the ratio of the total phosphoric acid contained in the plots receiving no phosphates to the phosphoric acid in the plots receiving phosphates, is a small one, viz : 1 to 1.7 ; whereas, the ratio of the available phosphoric acid contained in the plots receiving no phosphates to that in the plots receiving phosphates, is a comparatively large one, viz : 1 to 6. Speaking of the phosphoric acid soluble in 1 per cent. solution of citric acid, he says :—

"We find that the average percentage thus found in the eight plots receiving no phosphates was 0.0078 ; in the eight soils that received phosphates it was 0.0463. These percentages are in the ratio of nearly 1 : 6. The difference in the percentages of phosphoric acid soluble in dilute citric acid is thus comparatively overwhelming."

A consideration of these data in conjunction with the yields obtained, affords an argument of the very strongest character in favor of judging of a soil's fertility by its available plant food rather than solely by the "total" percentages of its constituents, and further, we have in these results of Dr. Dyer, coupled with the yields of barley, of Sir Henry Gilbert, emphatic confirmatory evidence of the immense value of the application of soluble phosphates. Other factors (season, mechanical condition of soil, &c.), being satisfactory, experiments show that crop yields are directly dependent upon the amounts of available constituents in the soil, prominent among which is phosphoric acid.

We may, therefore, inquire as to the sources from which this phosphoric acid can be supplied. They may be classified as follows :—

1. Bones—and their products.
2. Guanos.
3. Mineral phosphates, including Canadian apatite, Spanish, Norwegian, South Carolina, Florida, French and Algerian phosphates and coprolites.
4. Superphosphates.
5. Thomas—phosphate or basic slag.

To discuss the relative merits of these from an agricultural standpoint is of course impossible in the present paper. Suffice it to say, that the one great Canadian source of phosphoric acid is in the vast deposits of apatite found chiefly in the Province of Quebec. We shall, therefore discuss, first, our mineral phosphate in its finely ground condition, and secondly, as converted into superphosphate. Some data have already been given as to the solubility of raw phosphate in soil water, that is, water that we may suppose contains carbonic acid. Further results are, that, according to Williams, one part of finely ground phosphate dissolves in 140,840 parts of carbonic acid water, and according to Bisshof, 1 in 393,000. It will be noticed that while these co-efficients of solubility are widely divergent—evidently due to difference in methods of determination and the fineness of the ground phosphates—they all show a very low degree of solubility in carbonic acid water. We may, therefore, conclude that neither the phosphate rock particles either added to or originally present in the soil can furnish, as the result of the solvent action of the soil water, at any one time, more than very small quantities of available phosphoric acid. We are evidently not yet in a position to assign definitely a place in the scale of agricultural values to finely ground phosphates. No doubt the experiments now going on here and elsewhere will before long throw light upon this subject. Finely ground phosphate undoubtedly adds to the store of the soil's phosphoric acid that will in time become available, but it is equally evident that in the majority of instances it will well repay to previously convert it into a soluble form. In this connection, it is well to remember that the profit in farming largely depends upon the rapid conversion of plant food into vegetable products, which can only be done when such plant food is present in the soil in tolerably large amounts, and in immediately available conditions. I have always advised, as being more economical and profitable, methods and fertilizers which tend to immediately increased yields, rather than those which may be looked upon as permanently improving the soil. At the same time, it is worthy to note that phosphoric acid, unlike its sister essential, nitrogen, does not easily leach or waste in the soil. It is an accumulative fertilizer, very little passing off in the drainage water.

SILVER-LEAD SMELTING IN BRITISH COLUMBIA.

New Works of the Kootenay Mining and Smelting Co., at Pilot Bay, B.C.

[Opened 16th March last. Shipped in 30 days 600 tons silver-lead bullion, and from 25th May to 25th June 700 tons, or a total of 1,300 tons. This is a customs lead and silver smelter, having a capacity of 200 tons per day. It has been operated to date mainly on ores from the Blue Bell mine, one of the largest deposits of low-grade galena on the continent. 20,000 tons have already been shipped from this mine to smelting works. The mine and smelter employ at date about 200 persons.]

It has already been stated that the acid sap of rootlets is an important factor in soil food assimilation. We have also seen that Dr. Dyer has shown that the acidity of this root sap is equivalent in solvent power, on the average, to a one per cent. solution of citric acid. Following up the work already quoted, Dr. Dyer ascertained the solubility of various phosphates in this solvent. He found that 15.81 per cent. of the total phosphoric acid of finely ground Canadian apatite was rendered soluble by treatment in the cold with a one per cent. citric acid solution, when the proportion was one part of phosphate to 200 parts of solvent. His tabulated results are of interest, and I therefore take the further liberty of quoting them :—

CITRIC ACID EXPERIMENTS.

Strength of citric acid in solution.... 1.0 per cent. solvent material $= \frac{200}{1}$

	Per cent. of Total Phosphoric Acid.
Canadian apatite	15.81
Spanish phosphate	10.73
Aruba "	29.99
Belgian "	3.08
Somme "	30.36
" "	30.51
South Carolina phosphate	38.06
Another deposit of same	34.46
Cambridge coprolites	33.31
Raw Redonda phosphate	9.21
Calcined Redonda phosphate	16.06
Bone meal	100.00
Steamed bone flour	89.66
Basic slag or cinder	72.84
Peruvian guano—	
Pabellon de Pica	97.50
Punta de Lobos	76.67
Lobos de Afuera	87.23
Huanillos	74.16
Fish guano	91.46

My own results obtained in the laboratory at Ottawa, using one per cent. citric acid solution in the proportion of 1 part of phosphate to 100 of the solution, showed that when treating a finely ground phosphate containing, approximately, 25 per cent. of carbonate of lime, 6.2 per cent. of the total phosphoric acid was rendered soluble.

Dr. Dyer concludes, "As a matter of fact we know that finely ground mineral phosphates do afford an available, if not an economical, source of plant food, their value being determined mainly by fineness of grinding and specific hardness."

The experimental fertilizer plots at the Central Experimental Farm, Ottawa, are under the charge of Mr. Saunders, the director. In his report for 1893 he gives the data of the previous six years' trials with various fertilizers on the yield of different farm crops. He concludes regarding raw phosphate as follows :—"The crops given by plot 4 in all the series seem to show that mineral phosphate untreated no matter how finely ground has little or no effect as a fertilizer, and that the effects observable where nitrate of soda and wood ashes are used in conjunction with the untreated mineral are probably due entirely to the action of these added fertilizers. There is, however, no doubt that the mineral phosphate when treated with sulphuric acid and rendered soluble by being changed to the superphosphate is a most valuable addition to the fertilizing constituents of the soil.

"It would appear that, when the finely ground mineral phosphate is intimately mixed with barn-yard manure in an active state of fermentation and composted for several days, better results are obtained than would be expected from the proportion of manure used and it is probable that under these circumstances some portion of the mineral phosphate is rendered soluble by the action of the ferments in the decaying manure."

Various experiments have been made in our laboratory at Ottawa since 1893 towards a means of cheaply and effectively converting the phosphoric acid of ground phosphate into soluble and available forms, by means of sulphate and bisulphate, and carbonate of the alkali metals. The first report on these experiments, already referred to, is contained in the report of the Minister of Agriculture for 1893. It is there shown that the fusion of one part finely ground phosphate with the bisulphate of soda renders soluble a large proportion of phosphoric acid. Thus in one instance, phosphoric acid equivalent to 38.49 per cent. of apatite had been so converted. I may be allowed to quote from that report my conclusions as to the solubility of the phosphoric acid after ignition with the sulphates and bisulphates of soda and potash :—"I infer from these results (1) that any soluble phosphoric acid that may be formed during the ignition of the mineral phosphates with the sulphates of soda and potash immediately recombines in the presence of water to form tricalcic phosphate, and (2) that the ignition of the mineral phosphates with the bisulphates of soda and potash produces, according to circumstance, more or less soluble phosphoric acid.

"This latter conclusion is a very important one, since it is possible that by using the by-product sodium bisulphate an economical method for the treatment of mineral phosphates may be devised. It is scarcely necessary to add that such a process would prove of great value to Canada and Canadian agriculturists. Before an affirmative statement can be made regarding the commercial success of this method for converting and utilizing our phosphate, the cost of the raw materials and of the treatment, as well as the price obtainable for the manufactured article, must be taken into careful consideration."

Since that date, further work has been done, but has not yet been published. These latter experiments comprise the following :—(a) Heating together finely ground phosphate with sulphate of soda and treating the residue with 2 per cent. citric acid solution. The results showed that phosphoric acid equivalent to 35% to 37% of the phosphate had been dissolved by this solvent,

(b) Ignition of the finely ground phosphate with sodium bisulphate and treatment of the mass with 2% citric solution. In this case 50% of the apatite was found to have been rendered soluble in the acid solution.

The bye-product that was used in these experiments contained only a small proportion of bisulphate—the large part being sulphate of soda. It did not yield, therefore, as large an amount of soluble phosphoric acid as when a pure bisulphate was used.

These experiments, the results of which I have condensed, were made before the appearance of Dr. Dyer's paper. Consequently I was not then aware that 1% citric acid represented the acidity in root sap. My solvent was undoubtedly too strong to give results which allow us to say that the percentages of phosphates above stated are such as are rendered immediately available for plant use. Nevertheless, we may safely draw the conclusion that ignition of the finely ground phosphates with sulphate of soda, as well as with the bye-product, bisulphate of soda, does convert a considerable amount of phosphate into a form *much more readily available* than the phosphoric acid in the untreated material.

I intend to repeat these experiments, using 1% citric acid solution for the treatment of the ignited mass.

(c) The third series of experiments in this investigation conducted by us, afford data regarding the effect of igniting finely ground phosphate with wood ashes and carbonate of potash. A mixture of wood ashes and finely ground phosphate was heated together and the mass subsequently treated with water. In the aqueous extract, phosphoric acid equivalent to 1.25% of the phosphate was found. The residue after treatment with water was left over night in a 1% solution of citric acid ; this brought into solution phosphoric acid equivalent to 3% of phosphate. As the duplicate experiment in this trial closely agreed, we must infer that simple heating with wood ashes does not appreciably improve the solubility of the phosphoric acid in the mineral phosphate.

In the next experiment sand was added to the wood ashes and ground phosphate before ignition. This method was not found to increase the percentage of available phosphoric acid over that found in the preceding experiment.

Trials were then made by fusing together carbonate of potash and finely ground phosphate. Treatment of the mass with water dissolved phosphoric acid equivalent to 6.5% of phosphate and the subjection of the residue to the action in the cold of 1% citric acid further dissolved phosphoric acid corresponding to 43.00% of phosphate.

From these experiments, I conclude that ignition with wood ashes does not materially increase the availability of the phosphoric acid in apatite, but that ignition with carbonate of potash does so very materially. If commercially any of the processes that comprise heating ground phosphate with the sulphates and bisulphates or carbonates of soda or potash are practicable, undoubtedly we should have a means of readily rendering more or less immediately available much phosphoric acid now locked up and well-nigh useless to agriculture.

I may point out that if the potash salt were used in the fusion, the resulting fertilizer would contain in addition to the available phosphoric acid, another element of almost equal importance to farm crops—viz.: potash.

SUPERPHOSPHATES.

It is scarcely necessary for me on the present occasion to do more than very briefly refer to the universally recognized importance of superphosphate as a supplier of available phosphoric acid. Its method of manufacture need not now concern us. Briefly, by means of sulphuric acid the apatite is decomposed, a phosphate of lime soluble in water and sulphate of lime being formed. It is important, however, to remember that from various causes, superphosphate is apt to revert in the soil or simply by keeping the percentage of reverted phosphoric acid reducing that of the water soluble phosphoric acid. Reverted phosphate of lime is due to the formation of a compound intermediate between insoluble tricalcic phosphate and the water soluble, monocalcic phosphate, and is produced by the action of undecomposed phosphate or by the presence of iron and alumina in the raw material or to these constituents or lime in the soil. When reversion is caused in the soil by excess of lime, the deterioration in value, from an agricultural standpoint, is not nearly as serious as when caused by iron or alumina. The value of reverted phosphoric acid is a question of great dispute. Reverted phosphate is of vastly greater value than the insoluble tricalcic, but does not appear to be quite equal to that of the water soluble (monocalcic phosphate).

Superphosphate has been found the very best source of phosphoric acid for crops whose early growth must be hastened and for those whose season of growth is not an extended one. Thus, in the case of turnips, its application may advance the growth of the crop to such an extent that the plants are able to successfully resist the ravages of the turnip fly. For cereals, and especially barley, in conjunction with nitrogenous manures, it is specially valuable. In a fertilizer for pastures, potatoes mangels and other root crops it is also a most useful ingredient.

Available phosphoric acid in the soil has the tendency to bring about early maturity of the crop. As the season of growth advances the phosphoric acid migrates, accumulating in the seed. It is thus that the soil is particularly impoverished in this constituent when the custom of growing large areas of grain and selling their products off the farm is persisted in.

With regard to the rate of application of superphosphate, no definite amount can be stated as being the most economical for all crops and all soils. As a special fertilizer for fruit trees and orchards, it must be supplemented more particularly by some form of potash in addition to nitrogen. Roots also require liberal quantities of phosphoric acid, but for cereals superphosphate gives the best return when applied with available nitrogenous manures.

With barn yard manure, 100-300 pounds of superphosphate per acre will be probably the quantity most profitable to use. For special and intense farming, 300-500 pounds per acre may be applied together with a nitrogenous or potash fertilizer, as the case may require. As plant food in different soils varies so much in amount, and as plant requirements also vary greatly, it is impossible to lay down any hard and fast lines for universal guidance. Let us remember that any excess of phosphoric acid applied, is not likely to be lost, for it is not, like nitrogen, easily leached from the soil. Further, all farm crops require phosphoric acid and there are few of our cultivated soils in the older provinces of Canada that would not have their crop yields increased by an application of phosphoric acid in an easily available form.

LOSS OF PHOSPHORIC ACID TO THE DOMINION IN EXPORTS OF AGRICULTURAL PRODUCTS.

Very briefly, and in conclusion, I purpose stating the approximate annual outgo of phosphoric acid in our agricultural exports, a loss which should be made good if the original fertility of our virgin soils is to be maintained.

By means of the statistics given in the returns of trade and navigation for the Dominion, for 1894, and knowing the percentage of phosphoric acid in the products, I have compiled the following instructive table :—

ESTIMATED TONS OF PHOSPHORIC ACID IN PRINCIPAL AGRICULTURAL EXPORTS IN 1894.

	Tons
Cattle	800
Sheep	170
Bacon and meat	230
Wheat	2,200
Barley	120
Oats	360
Peas	870
Cheese	770
Hay	1,050
Bones	1,200
	7,770

This amount to be replaced would require 51,800 tons of superphosphate containing 15% phosphoric acid.

We manufactured last year fertilizers to the value of...	$244,469 00
And imported to the value of..........	16,978 00
Total........	$261,447 00
And we exported fertilizer to the value of..........	31,413 00
	$230,034 00

This at a valuation of $30.00 per ton represents 7,667 tons, and if we suppose such fertilizers to contain, on an average, 10% phosphoric acid, these 7,667 tons will contain 766.7 tons of phosphoric acid. Deducting this amount from the total outgo for 1894:

7,760
767
6,993

Practcally 7,000 tons of phosphoric acid is the amount our soil was impoverished by in 1894. Truly a very significant amount. In these calculations I have not taken into account the phosphoric acid exported in our wood ashes and lumber, no small amount.

It is, therefore, evident that our Government through its officers does well to call the attention of its farmers for their own profit as well as for the welfare of the country at large to the necessity of applying more phosphate to the land. The development of the phosphate mining industry and superphosphate manufacture must therefore undoubtedly prove beneficial to our Dominion and is worthy of all encouragement.

Canada—A Natural Manufacturing Centre for Fertilizers.

By Mr. Henry Wigglesworth, New York.

Fertilizers, in the empirical sense of the term, have been used by agriculturalists as far back as any records go. The earliest writers speak of the beneficial results derived from certain substances when put on the soil, at a period when the scientific knowledge of the cause was unknown; and that improved fertility resulted from the application of certain soils or marls, was at least known in the earliest days we can read of. Manure is spoken of in the Old Testament, and was unquestionably used commonly in the earliest days.

But the true knowledge of these strange properties, the underlying principle that marks the opening of the new era of scientific agriculture was left unexplained until 1862, when Baron von Liebig in Germany, and Sir John Lawes in England, explained the laws of nourishment that govern the growth of plants.

The light thrown in 1862 is the whole basis of our modern methods in agriculture. The laws formulated at that time,stand now more clearly than ever, to guide the agriculturists in farming, and the fertilizer manufacturer in compounding the necessary nourishment to sustain fertility in the soil.

Liebig explains so well the foundation of the theory that it may be well to quote this summary of his laws:

1. "A soil can be termed fertile only when it contains all the materials requisite for the nutrition of plants in the required quantity and in the proper form.

2. "With every crop a portion of these ingredients is removed. One part of this portion is again added from the inexhaustible store of the atmosphere; another part, however, is lost forever, if not replaced by man.

3. "The fertility of the soil remains unchanged if all the ingredients of a crop are given back to the land for fertilizing.

4. "The manure produced in the course of husbandry is not sufficient to permanently maintain the fertility of a farm. It lacks the constituents which are annually exported in the shape of grain, hay, milk, and livestock."

The rapidity with which the world at large made use of this knowledge shows how fully it was appreciated, and how much it was required. It was clear, fertilizers must have a different value from manure. The one must be a mixture of a number of chemical or organic compounds which, when complete, would form a perfect plant food. The other, while possessing in a small degree fertilizing qualities, is more of a mechanical assistant which by lightening and making porous, warming and protecting the soil, would do much that a fertilizer could not do.

Manure is a bulky and heavy material at the best, more than half water, and being only a residue, does not feed the soil with those elements which the crop extracted.

A fertilizer is a complete concentrated plant food, and its only equivalent would be to return to the soil in the form of ash, all those sheep and cattle and stock that feed on the land, and all the grain which is reaped from it.

The manufacture of fertilizers dates from this period. Even now it is an industry hardly thirty years of age. In England the product is still known as artificial manure. In the Southern States the term guano is very commonly used.

Guano had been known and used largely to augment farm-yard manure before Liebig's day; but its importation became so stimulated by the more advanced knowledge of its use, that by 1872 the beds were practically exhausted.

Chemical fertilizers had been making their appearance in Great Britain and the Continent of Europe in every agricultural centre; and as guano became scarce the production of superphosphate increased. Accurate statistics cannot be quoted to show how rapidly fertilizers were made use of, but the development of our phosphate mines is a good guide.

Canada has always had some dominant spirit, pointing the way and telling of its great natural stores of wealth, and as far back as 1848 Dr. T. Sterry Hunt described the great extent of our apatite deposits; but it was 1871 before mining operations of any importance commenced in the phosphate districts.

Statistics of the output of the Canadian mines hardly come within the scope of this paper. The history of apatite mining only concerns us at present where the manufacture of fertilizers influences or throws light on the subject.

Until 1889, almost if not the whole output of Canadian apatite mines went either to Europe or the States; a plain truth painfully realized by all interested in the Buckingham mines. To the influence and exertions of the Hon. Judge Hall, of Montreal, but at that time Member of Parliament at Ottawa, representing Sherbrooke, belongs the chief credit for a new regime in the industry. He had been for years working to get some suitable and enterprising company interested in Quebec as a centre for manufacturing fertilizers. He was sure of the field, and worked as Mr. Hall, and a man of strong convictions can. It was necessary to have the aid of some chemical manufacturer. Had it been sufficient to grind the rock and mix it with other fertilizing ingredients, the task would have been more easy, but sulphuric acid to render soluble the phosphate of lime, of which apatite is composed, was required in large quantities, and that demanded a very large outlay. Some strongly capitalized concern must be found. G. H. Nichols & Co., of New York—now known as the Nichols Chemical Company —had since 1887 been supplying the entire Canadian trade with sulphuric acid from the works they had erected at Capelton, in conjunction with their mining interest there. In 1889 the Hon. Mr. Hall was successful in persuading Mr. W. H. Nichols, the president of the company, to erect and start works for dissolving the apatite, and manufacturing fertilizers generally. They agreed, at the same time, to undertake the introduction and sale of the fertilizer throughout the Dominion, a task that they were very loath to enter, and which had largely deterred them from making a start earlier.

In the spring of that year the first and only manufactory of fertilizers was inaugurated at Capelton by G. H. Nichols & Co. Fertilizers were but little known in Canada; they had been purchased in small quantities from the United States by a few farmers in the Eastern Townships. The Government of Quebec had also imported, some years previously, a car-load of guano for general distribution at cost price, but it proved almost impossible to give it away, for among the French-speaking portion of the population fertilizers were absolutely unheard of.

The difficulty of introducing anything so new can therefore be imagined. The Government in the face of their guano experience and losses sustained at that time, felt indisposed to do anything and did nothing. Only the natural centre and the rich endowments of nature for establishing such a business made it possible. "The means that Heaven yields must be embraced and not neglected." The Hon. Mr. Hall felt this, and rendered great personal aid at all times.

The lower grades of apatite lay around the mine useless and unsaleable. The possibility of marketing this 60 per cent. phosphate induced the mining company to offer it at a very low figure. The railroads also saw a great future in transporting this material, and made low freight rates. Sulphuric acid was manufactured on a large scale from the pyrites ore mined at Capelton, and was produced at a low cost. With cheap apatite, cheap sulphuric acid, cheap labor, and low transportation rates, superphosphates could be manufactured and sold at low cost to the farmer, and they were. From the very outset in 1889 superphosphate analyzing from 8 to 10 per cent. of available phosphoric acid, which is equal to twenty to twenty-five per cent. of soluble phosphate of lime, was turned out and sold from the Capelton works at almost half the price 15 to 20 years of American competition had forced it to in the States. There the price was, and is now, little less than $20 a ton. The "Capelton" grade was offered at $10 per ton.

Agents were established in every centre of importance; pamphlets, circulars and letters were distributed in French and English to suit the districts as required. Salesmen familiar with the country and good linguists traversed every likely centre, from Windsor, Ontario, to Halifax, N. S. The subject was made interesting to everyone, and there was no excuse for not hearing of the great benefits derived from the use of a reasonable quantity of fertilizers. The most stubborn opposition could not have forced down the production and growth of fertilizers in Canada. The natural centre made itself felt. Farmers knew they were benefited by it. Metaphorically speaking the cheap raw material for their manufacturing was a boon to be quickly invested in.

The first year's sales were sufficiently encouraging so that in 1890 there was built and established a large factory sufficient, as was supposed, to satisfy the demand for some years. In the following year, however, it became necessary to double one department of the works.

From this time the home consumption of apatite entered into the statistics of the output of the Canadian mines. A desirable condition of things, for you can hardly expect to satisfy foreign buyers with what there is no faith in at home. In five years, from 1889 to 1894, the sale of fertilizers has increased ten fold. The larger part of this tonnage distributed itself over Quebec where the lands were more exhausted than in Ontario, but a large amount was shipped to Ontario, New Brunswick, Nova Scotia and Prince Edward's Island. The Nichols Chemical Co. now have a capacity at Capelton of about 30,000 tons complete fertilizers per annum, but if the demand warranted, it could dissolve 150 tons of ground rock per day.

Dissolving apatite is important and bears largely upon the question of the future of this rock's position in the markets of the world. At one time it was hoped grinding would be sufficient to render available its nourishing elements; but years of experiments have made certain, that results are too slow to satisfy immediate wants in infertile soils.

A ground phosphate rock is to all practical purposes useless as a fertilizer. The tricalcic phosphate which represents from 60% in low grades to 80% in high grades, must be decomposed by sulphuric acid into the soluble or mono-calcic phosphate of lime. Then the phosphoric acid which Mr. Shutt has spoken of in such a convincing way will become available. Rendering soluble the phosphate of lime is the most expensive as well as the most troublesome part in manufacturing. It helps none that Charleston and other nodular phosphates can easily be dissolved, apatite is of entirely different origin. It belongs to the oldest geological period, it is altogether harder to crush, more troublesome to grind more difficult to dissolve, than any nodular phosphate known or used. It is this that has given apatite the name it has, among consumers; for it is only too widely known among manufacturers.

At first each factory supposed in their case with superior knowledge and more modern plant, better success would be met with; but the best that can be done leaves it a more expensive raw material to work with than other competitive phosphates.

This is really a very serious obstacle confronting the miner of apatite, but on the other hand, he has a very much higher grade of phosphate rock to work upon. It is necessary for him, however, to use every modern contrivance and device to mine and cobb, and prepare the rock for the market in the most economical way possible. The expensive transportation between Buckingham and Montreal must also be reduced to a minimum.

Apatite can be used by the manufacturer, and used economically; indeed, did we not understand the nature of apatite, and had it defied our attempts to dissolve it, the method must soon be learned, but the South Carolina beds which are at present furnishing the larger portion of the world's supply are estimated to last only about 20 years.

The Nichols Chemical Co. have never yet, in their Canadian works, used one ton of anything but apatite mined in the Buckingham district. They would use it in their works in the States, if it could be purchased at a relatively low figure. They have analysis to show that apatite can be dissolved with a residue of one per cent. of insoluble phosphoric acid, a result quite equal to any work done in Charleston or any American phosphate rocks. Their regular work averages between one and two per cent. insoluble phosphoric acid, and such a low per centage left undissolved is considered satisfactory work by those who use the softer and more tractable Carolina phosphates. No one will find fault with apatite who obtains these results. It can be done, without doubt, but as stated, costs more in every stage. For this reason, those interested in the apatite mined must devise means to sell at a lower figure per unit than softer rocks fetch. It is reasonable to expect this with the knowledge that the manufacturer entails more expense by using it. At a lower price per unit apatite would be a more attractive phosphate than the softer rocks, for its high grade would attract, and be an incentive to attain economical results.

Last year the Buckinghan mines produced less than any year since operations were thoroughly established there. The output was less than half the tonnage of 1884—ten years previously. It is a serious state of affairs and requires us to look it in the face. In South Carolina, with a lower grade, but softer rock, the output keeps increasing steadily. There has not been time to ascertain the total tonnage, but 750,000 tons would be a fair estimate for 1894. This would be sufficient to make two millions of tons of complete fertilizer. A million tons, at any rate, are sold in the States. Canada's consumption of fertilizers bears no comparison whatever with this. When it does we shall turn out from the Buckingham district from 300,000 to 400,000 tons per annum. Do the parliaments of Quebec and Ontario, as well as Nova Scotia, New Brunswick and Prince Edward Island realize what this means? The western Provinces are hardly concerned yet.

The progress of the world depends upon the food supply of the world. The food supply must be proportional to the fertility of the soil. While we come into the world with nothing, and can take nothing out from it, we live on our grand-fathers. Every one of us consume and expend the stores nature has taken ages to accumulate, and in Canada we look on, doing nothing, while nature's stores are being steadily drained, our farming land fast becoming barren, and the average crop of all produce generally decreasing.

Throughout Ontario, there is an intelligent and level-headed class of farmers. The well tilled soil and clean farms bear evidence of the higher standard sought after, and yet Ontario (Canada's garden) produces an average yield of wheat less than half what it is possible to raise with the intelligent application of fertilizers. Sir John Lawes, on his experimental farm at Rothamstead, Eng., has growm wheat for thirty-eight years running without rotation, but with the use of fertilizers, and the average yield over the entire period of thirty-eight years is 36½ bushels of wheat weighing 59½ pounds to the bushel. Ontario's average yield is 17½ bushels per acre. Sir John Lawes, in the 46th year of his experiments, continuing this cropping without rotation and using fertilizers without barn manure of any sort, reports a yield of 35½ bushels of wheat, weighing 59¼ pounds per bushel. In other crops it proves the same way. The average yield in Canada where we have statistics to make comparison, makes a very bad showing alongside the average crops produced in Great Britain generally, and in Germany where high class farming has now become general.

"It is a condition, and not a theory that confronts us," and well deserves the consideration of this association. Are not we competing with Russia, India, Australia and the United States to supply the old world with grain, cattle, horses, butter, cheese, and farming produce of every sort? How can we hold our own unless the fertility of the soil is sustained. Progress, not retrogression, must be our watchword. It is not only that the crops are decreasing, but the standard of quality cannot be kept up. The weight per bushel, and the nourishing qualities in the grain can easily be detected by any farmer where the grain has been grown on a barren or in unfertile soil. Sunshine is not enough; nourishment is absolutely essential to a growing crop. Our ability to supply the world must be made known by increased average yield and improved quality. There is every natural condition to assist. Railroad and shipping facilities can certainly not be complained of. We have also got the most marvellously rich deposits of phosphate that have ever been discovered, to manufacture fertilizers, and improve the quality of our farm lands. These phosphates are practically unlimited. Those who have studied their occurrence most carefully see no possibility of exhausting them. If all the population of Canada were employed there, mining for years, the extent of the deposits would not be laid bare.

Nitrogen of Ammonia, another of the essential ingredients is also at hand in abundance. The destructive distillation of the coal mine in Nova Scotia for the production of gas will yield enough ammonia for an indefinite time. Sulphate of ammonia is now manufactured from the waste liquors of the Montreal Works, but some of the liquors are exported to the States where they are more willing to pay for them than we are.

Tankage azotine, dried blood and other nitrogenous materials that are excellant basis for assisting the fertilizer manufacturer—all products of the abbatoirs—are made quite extensively in Canada, but are exported to the States, as there is no home market.

Salts of potash alone, of all the necessary ingredients for sustaining plant life remain undiscovered in Canada. It happens that our soils are still rich in this element because there has been so much timber burned while clearing the land. Kainit, or some of the other salts of potash may be discovered before the supply is exhausted. Meanwhile, we are no worse off than our neighbors who have to import it in large quantities from Germany.

It must be evident that Canada has singular natural endowments to carry on the fertilizer business. That there has been great progress in the last few years is plain but we are still far from the high standard European farming has long ago attained. We ought to consume one thousand times the quantity of fertilizers at present sold throughout the Eastern provinces; and then the phosphate industry of Buckingham will be in the thriving and progressive state it ought to be in now.

The Government of Japan found it necessary to come to the front in assisting the introduction of fertilizers. Mr. Earle C. Bacon, one of the members of the Association, and a familiar face to the most of us, designed for the Japan Government an extensive fertilizer factory, which is now said to be in operation. Every nation has probably, in one way or another, subsidized agricultural investigation, and what would tend to advance scientific methods of farming. There is great need of assistance in Canada if we are to continue furnishing food supplies to the old world.

Canadian Phosphate and Fertilizers—Home Manufacture and Home Market.

By Mr. J. Burley Smith, M.E., Glen Almond, Que.

Canada, possessing inexhaustible deposits of the richest known phosphate of lime, with all the necessary materials for manufacturing superphosphate at home, has, for many years, merely exported this invaluable mineral, to the deprivation of her own agriculture, and to aid in glutting the overstocked markets of the world. And to-day all the phosphate mines of Canada are shut down, and an industry, which, under proper conditions, might have been not only a flourishing mining but also an enormous manufacturing business, employing thousands of men in its various branches, has been allowed to die a natural death; and the phosphate mining districts, where, for many years, thirty to forty thousand dollars of foreign capital were spent every month in hard cash, have now to reproach, not the foreign manufacturers, who can buy their raw material cheaper nearer home, but Canada herself and her capitalists, who have not only not invested capital in the working of her phosphate mines, but have failed to see that the possession of such a mineral was the nucleus of a mighty manufacturing industry, not only for home consumption and the benefit of home agriculture, but for export to foreign countries as a manufactured fertilizer.

Without doubt Canada could at the present time with her wonderful resources, manufacture superphosphate so cheaply as to compete with any manufacturing centre abroad, but the beginning should be for home consumption, and in this direction a demand is certain to spring up.

Once show our farmers that by spending a small sum in artificial fertilizers they can increase the yield of their farm produce many times in excess of the sum so spent, and they will not fail to avail themselves of this knowledge, and the home demand will follow as a natural result.

The province of Quebec could alone, with advantage, use the superphosphate manufactured from all the phosphate of lime raised in Canada, taking the best figures of annual production, viz: 27,000 to 30,000 tons per annum.

In travelling through many of the older settled parts of Ontario and Quebec, more especially the latter, one is struck with the great irregularity of crops, one half a plot often being rich and the other half poor, and only too frequently no crop worth speaking of at all. There is no denying the fact that the Canadian farmer, generally, has either not yet felt the want of, or has not yet been educated into the use of artificial fertilizers; and the general neglect to use even the farm-yard manure which appears to be considered more often as an impediment on his farm than a recuperative agent, shows that he is not familiar with the principles of reproductive economy in agriculture, a fact which is further emphasized by the small proportion of produce raised compared to the enormous area of land occupied.

The system of farming has been, and is now, to take out all that can be got, sell everything for cash and move away.

Mr. G. H. Turner, of Burgess, Miss., says in one of the numbers of the *American Fertilizer*:—

"The soils of America have been wantonly despoiled of their virgin freshness, and robbed of their exuberant fertility, by the old 'three-shift' or chop-down, wear-out and move-away system; the soil tillers selling everything available off the land and putting nothing back; moving westward (as fast as they had got what they considered the 'cream' of the soil) until there was no longer a 'west' to go to; and in their migrations westward, they oftentimes left behind them all that made life worth the living—friends, society, good and convenient markets, good roads, and oftentimes wood and water—for what? For the sake of cultivating for a few more short years, virgin soil; and to postpone the evil moment as long as possible of paying the altogether too long deferred debt that they owed to Dame Nature, in the way of returning to the soil a modicum of that fertility (in the shape of manure and chemical fertilizers) that had so ruthlessly been removed from the soil by the various crops grown thereon, but sold as cash crops off the farm. The era of chemical fertilizers is here; there is no dodging the question nor disputing the facts in the case; it is here, and it is here to stay."

The same may be said of much of Canadian North America. The constant exodus of her sons shows that the old homesteads are not prolific enough, under present conditions, to do more than support the old folks, and that though the acreage is large enough to employ the additional labour, the elements of fertility are wanting. The phosphoric acid has been taken out from the land and none returned to it.

The avidity with which Canadian farmers are learning all that can be taught them in the making of cream, cheese, and butter, shows that both eyes and ears are open; and that their world-famed reputation in this direction has not been without its encouraging effect; and they are ready for fresh knowledge.

"The era of chemical fertilizers is here" and let us hope "it is here to stay." The splendid Government Experimental Farm at Ottawa is an open book for all to read, but that is not enough. The knowledge obtained by intelligent chemical experts there must be proclaimed from the house tops and from the street corners.

The good work of Prof. Robertson in lecturing on milk, cream, butter and cheese, etc., must be followed up by lectures on fertilizers, How, and in what quantity they should be used, their cost, and the kind best adapted to the different natures of soils and crops, with full information as to how they can be purchased.

Thus demonstrating how the land can be induced economically to yield more and still continue fertile.

Lectures must be given at the frequent meetings of the various local agricultural societies. Practical instruction in simple style must be sown broadcast, and an intelligent and appreciative people will quickly mark, learn, and inwardly digest the facts laid before them. The result will be a demand for fertilizers, improved and more regular crops, and the consequent well-being of our farmers.

A new home manufacture will be developed, a dormant mining industry will again flourish with increased vigour, great numbers of miners and laborers will find regular employment, and this time the industry will come to stay.

Situated on or near the banks of river du Lievre, which runs through Buckingham and the neighbouring townships, are the well known phosphate mines, now unfortunately idle, The Emerald, The British Phosphate Co., The Little Rapids, The North Star, The High Rock, Glasgow, The French Phosphate Co., Union, etc., to say nothing of the enormous areas of unworked phosphate lands on both sides of the river. And the river itself, formerly alive with steamboat, tug and scow, freighted with rich cargoes of mineral, is now silent and deserted save for a daily passenger steamer.

Three miles from the mouth of the river du Lievre stands the picturesque town of Buckingham notable for its magnificent water power, a portion only of which is utilized to drive the great lumber mills of Messrs. J. MacLaren and Ross Brothers, leaving a splendid surplus for other manufacturing trades, which must, sooner or later, make this promising town hum with the busy whirr of machinery.

The Buckingham branch of the Canadian Pacific Railway passes through the town and has its depot on the wharves of the river du Lievre, a little above the falls, where, a year or two ago, the phosphate mined up river was brought down by boat, loaded into cars, and conveyed to Montreal by rail, and thence shipped for use in the fertilizer manufactories of Great Britain, Germany and elsewhere, whose manufactured product in the shape of superphosphate found its way back occasionally even to Canada and the United States.

By a happy combination of circumstances and the ability to recognize and use them many a man has amassed an enormous fortune.

Observe the happy combination of circumstances here.

Buckingham town possesses abundant water-power which is available for grinding, pulverizing, and separating the phosphate ore and working the machinery of a manufactory generally, and the town is situated at the junction of the Canadian Pacific Ry. with the river down which the mineral is brought from the mines.

The two most important elements in the manufacture of superphosphate are phosphate and sulphuric acid. It is known that we have abundance of phosphate and the sulphuric acid could either be made on the spot or purchased elsewhere very cheaply. For a long time brimstone was the raw material almost exclusively used for producing sulphuric acid and was imported chiefly from Sicily, but it is now known that pyrites, or the sulphide of iron, is equally good and much cheaper where chemically pure acid is not required.

It is also well known to those who have searched for and mined phosphate that pyrites is exceedingly abundant in a phosphate distrct and if sought after as a mineral to mine instead of, as hitherto, to avoid, except as an indiction of other minerals, no doubt it could be obtained in very large quantities indeed. Some time ago a boring test in a phosphate mine passed through a deposit of iron pyrites fifteen feet thick, which, being of no value then was simply left and avoided. But supposing this were not taken into consideration; sulphuric acid is manufactured already at Capelton and could be delivered at Buckingham as cheaply as at superphosphate works anywhere.

The cost alone in freight of shipping phosphate to the superphosphate manufacturers of Great Britain and Germany averages not less than five to six dollars per ton; the cost of freighting the phosphate down the river du Lievre to a factory at Buckingham would certainly not exceed all round seventy-five cents to a dollar a ton.

To lessen the heavy freight charges to Europe manufacturers stipulate for the highest grade of phosphate viz: 80 to 85% first grade, and not less than 70% for second grade, in order that all extraneous matter, such as pyroxene, feldspar, waste mica, pyrites, etc. should be eliminated before leaving the mine.

To achieve this involves a very expensive system of mining; in the first place great care must be observed in blasting the mineral so as to keep it separate from the associated rock, then the crude mineral has to be sorted, screened, picked, and again sorted by a great number of men and boys, and it is only by using the greatest care that the maximum of each grade can be reached; too often at a cost which has precluded any chance of profit to a mine owner.

Owing to the almost uniform specific gravity of the associated minerals, with the exception of pyrites, no perfect mechanical method has yet superseded hand separation, which has probably cost more than the actual mining or winning of the mineral.

But from various experiments made by the writer he is confident that this can be accomplished successfully when once the experience of specialist machine makers has been brought to bear on the subject, and providing that the cost of operating the machinery be minimised by the economical use of water power; the item of steam machinery being a very serious one at each mine.

Although the difference in specific gravity is so slight as to render sedimentary separation difficult, still there is a difference which makes the process, though slow, not impossible, and the various atoms have peculiarities in shape and moving tendency which taken advantage of by special machinists cannot fail to result eventually in a perfect automatic method of separation.

If a manufactory were established at Buckingham—than which no more suitable locality could be found—nearly all the required separation would be made at the manfactory there, as the cost of freight from the mines being so slight would not preclude the carrying of a certain amount of extraneous matter, thus affecting an important economy, both in mining and manufacturing, at the very beginning.

Not only could the Canadian raw material be delivered at the manufactory here at from five to six dollars per ton cheaper than it could to European manufacturers (because of the freight and handling charges which now exclude it from those markets) but a lower grade mineral would be sufficient, therefore the aggregate yield from each mine would be proportionately greater and cost less, as there would be little or no waste and a great economy would be effected in the winning and handling.

The works at Buckingham being situated close to the Canadian Pacific Railway, the finished fertilizers could be distributed to consumers at rates which must defy the competition of any imported article.

The town of Buckingham, alive to the advantages of having such an important manufactory established in her midst, and a revival of the great phosphate mining industry, which contributed so much to her rise and prosperity in the past, will doubtless come forward with the offer of an adequate bonus or help in some shape or other to accomplish such a desirable consummation.

It may be confidently expected also that the Government, ever ready to aid Canadian agriculture and foster her infant manufactures, will take measures to encourage and assist this two-fold industry, which is assuredly of national importance.

Mr. R. W. Prittie—I feel repaid by Mr. Shutt's able paper for having come all the way from Toronto to attend this meeting. When I was in England some thirteen years ago, an old gentleman showed me a grape-vine from which he sold £200 worth of grapes every year. He told me he was feeding it with "something from Canada," and I have little doubt he was using Canadian superphosphate. A gentleman at Richmond Hill was telling me the other day that he uses Canadian superphosphate on his fruit-farm of sixteen acres, and he always has a good crop and can sell his berries and small fruits for a cent a box more than his neighbors. I think it is the duty of the government to do more effective work in the future in developing the phosphate industry than they have done in the past, and when I go home I shall write to the Minister of Agriculture and give him my view of what I have heard to-night.

Hon. Mr. Flynn—In what shape is phosphate utilized in other countries? Have they ever tried it in the ground form?

Mr. Shutt—The finely ground phosphate has practically no market. What has come in of late years is Thomas slag, a by-product in the manufacture of Bessemer steel. Great heaps of this accumulated at iron-works, and it was found to contain phosphoric acid in a form which was partially available for plants, and so it has been largely made use of on the continent of Europe. It seems to stand intermediate between finely ground phosphate and superphosphate. It is to a certain extent available, but not so much so as phosphoric acid. England uses superphosphate more particularly, while Germany uses a great deal of Thomas slag and phosphate, which comes from Algiers and other countries.

So long as money is lying in the bank not gaining interest, it is of no value to anybody, and just so with plant food in the soil. It is only when it is bearing interest that it is of value, and we may look upon crops as the interest. The whole science of farming may be summed up as being the conversion of mineral constituents into vegetable products, which are afterwards food for man and beast. The more rapidly we can accomplish this the more quickly do we get returns upon our capital.

With regard to any action which may be taken by this convention as to urging any mode of action upon the government, I think it is well to begin at the beginning. In my opinion the first duty of the government is to do the teaching. Let them by means of pamphlets, lectures, etc., issue such instruction as to the uses and value of superphosphate as the people are in a position to intelligently put into practice. Let them show the farming community that it will be to their advantage to use superphosphate as a fertilizer, and the effect upon the phosphate industry would soon be very marked.

Mr. J. Burley Smith—Mr. Shutt has shown us that an enormous quantity of phosphoric acid is every year being exported from the country in the form of agricultural products, and it is therefore evident that the necessity of returning phosphoric acid to the ground here is far more imperative than in Europe, whence it is not exported to anything like the same extent. Where the products of the farm are fed upon it, and the phosphoric acid is returned to the land in the manure, the loss is not so great; but where the products are constantly exported the drain is very severe. With regard to the question of using raw phosphate, I think we may rely upon the agricultural chemists, who have practically settled the point for us. They have gone exhaustively into the matter, and have proved that treated phosphate is the best form of fertilizer. I quite agree with Mr. Shutt as to the educational aspect of the question. From several inquiries I have myself lately received from people in my own neighborhood, I am of the opinion that the farmers really want information. If this whole matter were put in some easily understood form and placed in the farmers' hands, I believe they would be found willing to apply the information thus received. This would create a home demand, which would establish the industry with but little assistance from the government. The facilities for manufacturing superphosphate here are very great, and it has always appeared very curious to me that we should send our raw material several thousands of miles away to be manufactured, and then import back some of the finished product by way of the United States.

With regard to some of the statements made in Mr. Wigglesworth's paper, I think the sulphuric acid should be brought to the phosphate, not the phosphate to the sulphuric acid. It appears to me that Buckingham is the place where the manufacture of superphosphate should be started, and if this were done the cost of production would be reduced. The mineral must be ground very fine and separated by mechanical means to remove everything that is not phosphate, so that freight may not be paid upon it. At Buckingham there is abundance of water-power, and a good deal of the separation that is done at the mines might be done more cheaply there. The cost of floating the mineral down the river to the place of treatment would be very small. In every case, except that of Capelton, the sulphuric acid is brought to the seat of manufacture of the superphosphate fertilizer. In London, England, the bulk of the sulphuric acid comes from Spain. The phosphate would certainly not bear the cost of taking it to Spain to be treated. It seems to me self-evident that the manufacture should be done where we obtain the mineral.

Mr. A. W. Stevenson—The commercial aspect of the question is in danger of being lost sight of. The poor farmer in Manitoba, for instance, who cannot get more than ten or fifteen bushels of wheat per acre, realizes a return of from $6 to $9 per acre; how much can he spare out of this amount to buy fertilizers? He is very badly handicapped besides, having to send his product to market in England, and having to pay freight on the fertilizer from Quebec.

Mr. Shutt—Canada cannot compete in wheat growing with some of the countries in South America. The salvation of Manitoba is the dairy industry. The unskilled labor of South America enables them to produce wheat cheaply, but our labor is expensive, and we must put it into a channel where it will yield us a profit. The people of Manitoba are beginning to see this, and they are going largely into the dairying industry now. Besides, their soil is not in the same condition as the soil in the older provinces of Ontario and Quebec. It contains a larger percentage of phosphoric acid, and it will be some years before there will be any great necessity for fertilizers there.

Mr. Jas. King, M.P.P., for Megantic—I profess to be more of a miner than a farmer, and join with the chairman in regretting that circumstances would not allow the Minister of Agriculture to be present, as I am sure that he would have taken a great interest in the papers that have been read. It is part of the policy of the Department of Agriculture to have gentlemen going about the country giving lectures on agriculture, and I think for the furtherance of the apatite industry it would be important to have among them men with personal experience in the use of superphosphate. it would have a great effect on their agricultural audiences. As a rule, an agricultural audience has a great horror of theory, but if you could bring forward a man who has made use of superphosphate or fertilizer of any kind, and who is able to say it has been of great use to him, you could carry conviction to the mind of agricultural hearers on that point. I said I was not a farmer, but we happen to have a home-farm on which we have had occasion to use superphosphate from Sherbrooke. Our farmer, who is a conservative man and does not like new notions, is willing to admit that he considered this superphosphate much cheaper than any manure he could get in the neighborhood, and he was in a position to get manure from farmers and others in the vicinity at a very low cost. He said he found a very marked improvement as a result of using the fertilizer, in comparison with the effect produced by ordinary barn-yard manure. Evidence of this sort I consider valuable. I am quite sure that if the government could make it clear to the farmer that he could put $10 or $20 a year into these fertilizers with advantage, the consumption of them would largely increase. Speaking generally, I may say that within the last four or five years, farmers have taken heart in this province. Their returns from creameries, etc., have enabled them to look much more favorably on a farmer's lot than they had been able previously to do. (Applause.) I think they are now encouraged to take up modern methods of increasing the yield of their farms.

I regret the unavoidable absence of our old friend, the Hon. Mr. Irvine. We all understand the reason, but we know that his heart is with us, and that the Association has always had his support. At the same time, with the Commissioner of Crown Lands in the chair, the Mining Association of Quebec is in its natural position with reference to the government. It is fitting that the gentleman charged with the administration of the mining resources of this Province should frequently meet and come into conference with the men who actually do the mining. Speaking for myself and the miners generally, I feel that the official head of the mining department has been most anxious to work with us in every way within his power. (Hear, hear). This fact has given great support to the feeling of security with which mining is carried on in this Province under the government regulations. (Applause).

Mr. G. V. Chown—I beg to suggest that the convention memorialize the governments of Ontario, Quebec and the Dominion to disseminate amongst the farmers information dealing with the nitrogenous, potash and phosphoric elements in manure.

Mr Thomas W. Gibson—The papers which have been read have been very interesting and valuable, in particular that of Mr. Shutt, who has given us a comprehensive and lucid survey of the whole field. If I might add a word, it would be that, in applying fertilizers it is necessary to consider (1) the necessities of the soil and (2) the requirements of the crops to be grown. A fertilizer which would be of great use on one soil might not be suitable to another. For instance the application of superphosphate to a soil already containing an excess of lime might be of little benefit, while such a soil might be in great need of manure containing nitrogen or potash. Certain crops require generous supplies of phosphoric acid, and for these superphosphate is an ideal fertilizer; others must have more of nitrogen or potash, and hence arises the necessity for choosing the fertilizer with the view of furnishing as nearly as possible the element or elements of nutrition required. We in Canada are for several reasons much behind European countries in the use of artificial manures, and there can be little doubt that it would be of great benefit to the agricultural industry if their employment could be extended. No doubt the Provincial and Federal governments can do something to this end, and by means of researches at the Dominion and Ontario experimental farms, something has already been done. The most feasible method of govermental assistance would seem to be by supplying information to farmers on the proper use of fertilizers and the benefits to be derived from them. I am inclined to doubt the wisdom of giving anything by way of a bonus to manufacturers, and this would be unnecessary if a market could be created for their product. The way to create a market for superphosphate is to convince the farmers that it would pay them to use it. Let reports and papers such as that read by Prof. Shutt be printed in handy form, not buried in the obscurity of a blue book among other papers on entirely different subjects, and let these be generously distributed among the farmers. This seems to me the best possible way of extending the market for superphosphate.

Mr. B. T. A. Bell moved that a vote of thanks be heartily accorded to Mr. Wigglesworth and Prof. Shutt, who were not members of the Association, for the excellent papers they had furnished.—Carried unanimously.

Hon. Mr. Flynn—The thanks of the meeting are certainly due to the gentlemen who have read the papers here to-night. Mr. Dean has given us an admirable account of the development of electricity as applied to mining, a subject which I have no doubt is bound to come to the front in a very short time. The papers read on the phosphate question dealt with the subject from various standpoints. They were all excellent, but I think I only express the sentiments of all present when I congratulate

Prof. Shutt in particular upon the able and complete manner in which he has presented the question. (Hear, hear.) I agree that the best way to popularize the idea of using fertilizers is to educate the people up to the point of appreciating their value, and it occurred to me while listening to Prof. Shutt's paper that it would be of great advantage to the farming community if it were published in pamphlet form and distributed as widely as possible. Speaking as the Commissioner of Crown Lands and as a member of the Government of Quebec, I am convinced that the question of extending the phosphate industry is now ripe for government encouragement. It must be admitted that our lands are in need of fertilizing, and the moment you can show to the governments of the Provinces and the Dominion that superphosphates is an excellent fertilizer, that moment it becomes the duty of the several governments to encourage those who are prepared to work the phosphate mines and convert the output into fertilizers. To do this is only in harmony with the policy of these governments, and so far as the Government of Quebec is concerned, I feel that all that is required is to bring the matter to the notice of the Minister of Agriculture, and I believe a most favorable response will be experienced. (Applause.) The Dominion Government has larger means at its command, and with the Experimental Farm has a larger field to work in, and why should the Dominion and the Provinces not have one policy in this matter? Why should they not work together to establish the industry and to create a home market, which, when created, would cause the business to be self-sustaining, and do away with the necessity of any further encouragement? Mr. Gibson has said that he was not inclined to view with favor the proposal to grant a bonus to the manufacturer. Well, it is a question for consideration how the industry should be encouraged. Would it pay at the present time to manufacture superphosphate? Until you get the people of the different Provinces to accept this fertilizer and the industry becomes self-sustaining, should there not be some helping hand? We are acting on this principle every day. In Quebec lately we granted a bonus of one cent per pound on butter in order to place it on the English market, and we also give aid to the beet sugar industry. I admit that action of this kind belongs specially to the sphere of the Dominion Government, and I am expressing my own personal opinion, not necessarily that of the Quebec Government, when I say that I believe the moment is now opportune to move in the direction indicated with regard to the phosphate industry. (Applause.) The governments of the Dominion and the several Provinces cannot do better than apply a portion of their money in this useful manner. I feel that I would be doing a good thing if by such a policy I could cause the mines in the Ottawa region now lying dormant to be worked, and in such a case I can tell you I do not anticipate any trouble as regards the question of royalty. (Laughter.) I read the other day that in South Carolina, whence phosphate is exported in considerable quantity, they have had some trouble about royalty. Now, there is no royalty in the Province of Quebec, and I think I can promise you that there will be none in the future. (Cheers.) The development of the phosphate industry would enhance the value of the phosphate lands still belonging to the Crown, and in this way I would be enabled to add to the revenue derivable from this part of the public domain. I may without indiscretion tell you that in my next report I shall have the pleasure of showing an increased income from mines in spite of the general stagnation throughout the Province and country. Mr. Wigglesworth in his paper treated the subject from the manufacturer's point of view. It seems to me that what Mr. Smith has said commends itself to every unbiassed mind. Why should not the phosphate be converted into superphosphate at the place where it is extracted from the ground? Why should not the lighter article be carried to the heavier, rather than the heavier to the lighter? Gentlemen, I believe that with an enlightened public opinion on the one hand which would welcome superphosphates as a fertilizer, and proper governmental assistance on the other, there is a great industry to be established which would redound to the benefit of the country as a whole. We have met here to promote the welfare of our common country, and if this should be the outcome of our efforts we shall have achieved a worthy end. (Loud applause.)

The meeting then adjourned *sine die.*

Silver Mining in B. C.

The following is excerpted from the Gold Commissioner's annual report for the West Kootenay district B. C.

Blue Bow.—Situated on Carpenter Creek. On this claim development work consists of 1800 feet of tunnelling and 200 feet of drifts. Shipments have been made from this property amounting to 240 tons, and there are 70 tons of ore now on the dump. The average assay is 137 oz. silver and 75 per cent. lead.

Cumberland.—In the Idaho Basin, has 400 feet of tunnelling on it, and gives employment for six men. The ore is of a high grade, and there are about 55 tons on the dump awaiting shipment.

Mountain Chief.—This claim, situated on the Payne Mountain, has shipped 100 tons of ore, averaging 214 oz. silver and 71½ per cent. lead, and has 75 tons of the same quality on the dump. Eleven men are employed on this property. The development work consists of 300 feet of tunnelling.

Slocan Star.—This mine, which is one of the most promising in the sub-division, is situated on Sandon Creek. The shipments this year amount to 840 tons. On the dump awaiting shipment are 300 tons more, besides 8,000 tons of concentrating ore, which will be handled as soon as the Company erect their concentrator. The ore averages 100 oz. silver and 70 per cent lead. Seventeen men are steadily employed, and the development work consists of 1,180 feet of tunnels, and 180 feet of a shaft.

Idaho.—This claim, situated in the Idaho Basin, bids fair to be a very valuable property, not only on account of the rich value of the ore, but on account of the immense bodies found. On this claim 1,300 feet of tunnells have been run, and 100 feet of shafting. Thirty-five men are employed. Two hundred and seventy-five tons of ore have been shipped, and there are on the dump awaiting shipment 270 tons of high grade ore and 4,000 tons of concentrating, which will be shipped to the concentrator at Howsen Creek as soon as it is finished. The average of the ore is 185 oz. silver and 68 per cent. lead.

Alamo.—This mine is situated in the Twin Lake Basin. On this claim the development work consists of 675 feet of tunnells and 160 feet of shafts. The average of the ore is 200 oz. silver and 60 per cent. lead. Forty tons have been shipped, and on the dump there are 40 tons of high grade ore and 800 tons of concentrates. Twenty-five men are employed on this property.

Deadman.—This claim adjoins the Noble Five Group, and gives employment to six men. The ore averages 150 oz. silver and 50 per cent. lead. No ore has been shipped from this claim. About 250 feet of tunnels have been run as development work.

Washington.—This claim is situated in McGuigan Basin, but has not been working for the last three or four months. Fifteen hundred tons of ore have been shipped from the claim, averaging 140 oz. silver and 60 per cent. lead. Over 1,000 feet of tunnelling and shaft work have been driven on this mine.

Ruecau.—This claim is situated near the Noble Five, and employs 12 men. The development work consists of 630 feet of tunnels and 125 feet of a shaft. Eighty tons of ore have been shipped, showing a return of 176 oz. silver and 76 per cent. lead.

Noonday.—On Cody Creek, has shipped 20 tons ore, but the grade is lower at present than those claims mentioned above, averaging 75 oz. silver and 70 per cent. lead.

Wonderful.—On this claim 680 feet of development work have been done, but no ore has been shipped. Twenty-two men are employed. About 1,400 tons are, however, on the dump, consisting of shipable and concentrating ore.

Omega.—This claim is situated on the Noble Five Hill, and employs 10 men. The development work consists of 300 feet of tunnels and shafts.

Noble Five Group.—On this group of claims 1,700 feet of development work have been run, and 600 tons have been shipped. Twenty-two men are employed. The value of the ore is 150 oz. silver and 70 per cent. lead.

Mountain Chief No. 2.—This mine is situated between New Denver and Three Forks, and employs 10 men. The value of the ore is 170 oz. silver and 75 per cent. lead. Six hundred and sixty tons have been shipped, and there are over 2,000 tons of concentrating ore on the dump.

Alpha.—This claim overlooks Silverton and Slocan Lake. The development work consists of 500 feet of tunnels. Eight hundred tons of ore have been shipped, averaging 120 oz. silver and 64 per cent. lead. The mine employs 24 men.

Fisher Maiden.—Situated near the head of Four-Mile Creek, has development work consisting of 400 feet of tunnels. Ten men are employed. Fifty tons of ore have been shipped, averaging 230 oz. silver and 10 per cent. lead.

Read and Robertson Group.—Situated six miles east of Slocan Lake, is not at present being worked. The development work consists of 600 feet of tunnels. The ore averages 120 oz. silver and 75 per cent. lead.

Thompson Group.—This set of claims is situated on the head-waters of Four-Mile Creek. Five men are developing the property, which has a strong ledge traceable for 1¼ miles. The character of the ore is the same as the Fisher Maiden, and as depth is gained the galena disappears, leaving a high grade dry ore.

On 8-Mile and 10-Mile Creeks numerous discoveries were made this summer. The Kalispell, on 10-Mile Creek, located in August, is the most promising. The locators are at work, and have 7 tons of ore, averaging between 400 and 500 oz per ton. This is a very large ledge, and is situated close to Slocan Lake.

The Enterprise, on 8-Mile Creek, has a large showing, the ore averaging 250 oz. to the ton. The ledge has been stripped in twenty different places, and each shows no less than two feet of galena ore.

Vancouver Group.—Situated 4 miles up 4-Mile Creek, employs 4 men. Fifteen tons have been shipped, averaging 233 oz. silver and 60 per cent. lead. The development work consists of 600 feet of tunnels and shafts.

A concentrator, with a capacity of 100 tons per day, is being erected at the junction of Howsen and Carpenter Creeks, and the machinery for same is now on the way in *via* the Nakusp and Slocan Railway. This is the first machinery for the Slocan country.

NELSON SUB-DIVISION.

Hall Mines.—This Group of mines, owned by the Hall Mines, Limited, comprising the Silver King, Kootenai Bonanza, and American Flag, are situated on Toad Mountain, Nelson.

The principal workings are on the Silver King ground, and have been pushed forward with the sole idea of developing the Company's property. A small amount of stoping has been done since June, 1894, and since the commencement of operations in the summer of 1893 about 4,000 tons of ore have been extracted. Of this quantity (principally produced through development work) 640 tons have been shipped to various smelters, and the returns show an average value of 116 oz. in silver, 12½ per cent. copper, and $2 per ton in gold.

This Company has been the first in the district to employ diamond drills for prospecting, and has now in operation one hand drill and one power drill of 1,200 feet capacity. The Company has also a complete plant—boiler, engine, air compressor, etc.—to serve the power drill, at present 1,600 feet distant, with air and water.

Since the Hall Mines, Limited, purchased the property from the original holders, the development work has shown that the large body of ore which was known to exist at the time of the purchase has increased in area, carrying the same uniform grade of ore.

The expenditure by the Company on this group of mines will probably amount to $100,000.

The number of men employed regularly in this group is 50.

Dandy.—Situated on Toad Mountain. Very little development work has been done on this property, but it is the intention of the owners, with the prospect of the smelter on Kootenay Lake nearing completion, to commence operations and ship ore at no distant date.

Starlight.—This claim, situated on Toad Mountain, and parctically newly developed, shows great promise of being a rich gold property.

The vein is about five feet wide, and the ore has an average of $20 per ton in free gold. A shaft twenty feet has been sunk, and the uniform grade of the ore has been maintained. On the surface the vein has been stripped for a distance of 700 feet.

Fern Group.—This group of claims situated on Hall Creek have been bonded for $35,000. The claims are free milling, and have a reputed value of $20 per ton in gold.

AINSWORTH SUB-DIVISION.

The completion of the Pilot Bay smelter, the property of the Kootenay Mining and Smelting Co., has given a stimulus to mining in this section.

This Company owns the famous Blue Belle group, and several others in the Ainsworth and Toad Mountain camps, from most of which they will extract ore as early as possible. About the works at Pilot Bay nearly 100 men are now employed. The buildings are of brick, with corrugated iron roofs, and are equipped with various machinery of the most modern type, a battery of boilers of 200 h. p., smelters stacks capable of handling 100 tons of ore daily, sampling works with a capacity of 150 tons per day, and concentrator of like capacity.

A large and substantial wharf has been erected, and warehouses and ore-bins. It is predicted that the opening of these works will prove of great benefit to the people of the district, and particularly to those who are unable, from various causes, to send their ore to distant smelters.

The Blue Belle mine, on the ore of which the Company relies for much of its fluxes, has over 3,000 feet of tunnels, shafts, uprises, etc., completed and is in a position to turn out 150 tons of ore per day.

No. 1 Mine, Ainsworth Camp.—This mine is working under a lease, and on it a 60-ton concentrator has been erected, through which 500 tons of ore has been passed, with a result of one ton to seven. Two thousand five hundred feet of flume has been built, introducing water for the concentrator.

Lady of the Lake.—This claim has a promising body of ore, to work which the owners have put in a syphon to drain Loon Lake, which is being lowered rapidly.

King Solomon.—A shipment of five tons of ore from this mine realized 160 oz. in silver and 40 per cent. lead.

Little Mamie.—Since the conveyance of this claim to Mr. W. McVicar, of Nova Scotia, it has been worked with a force of 15 men, and shows a 30-inch body of concentrating ore.

Little Phil and Back Diamond.—Two ore veins have been reached by a joint tunnel, run on the dividing line between the two claims, one showing high grade ore. On the other, ore is being extracted and prepared for shipment.

United.—The yield from this mine, it is intended, shall be treated at Pilot Bay, and if found to be satisfactory the mine will be worked permanently.

Highland.—One tunnel 230 feet; another, 100 feet above, 90 feet long. The face of this drift shows 3 feet of ore. Three hundred tons of ore are now on the dump.

On the Wakefield, Budweiser and Amason are 250 feet of tunnel, and ore averaging 30 oz. silver and 45 per cent. lead has been found.

Morning Star.—This claim has ore averaging 60 oz. silver per ton.

Skyline.—This claim is not at present being worked, but it has completed large workings, and has several hundred tons of ore, averaging 80 oz. silver on the dump.

KASLO CAMP.

Eureka.—Extensive development work has been done on this claim. A 190-foot tunnel has been run, cross-cutting the vein at a depth of 170 feet. The vein shows a 30-inch body of high grade ore. About $10,000 has been expended in improvements, etc. Ore shipments have been commenced, and it is expected that about 200 tons will be shipped.

Echo.—An 18-foot tunnel has been run on the ledge, exposing an 18-inch body of ore.

Iron Crown.—A tnnnel, 110 feet, has been run to cross-cut the vein.

San Berdino.—A 70-foot tunnel has been run to intersect the ledge.

Solo.—A 50-foot tunnel has been run on the vein, and a large quantity of ore is on the dump.

Wellington.—About 350 feet of sinking and tunnelling work has been done, which has shown up a 2½-foot body of ore. A 50-ton shipment of this ore has been made, showing good returns, and shipments will continue during the coming winter.

Virginia.—About $6,000 worth of development work has been done on this claim.

Carbonate.—Two tunnels have heen driven, in all about 250 feet, which show up a nice body of ore. A 3-mile trail has been built to the waggon road, and it is expected that two carloads will be shipped as soon as raw-hiding commences.

Charleston.—On this claim, about $2,000 has been expended in tunnels and drifts.

Lincoln.—A 60-foot tunnel has been run to catch the vein.

Utica.—About $2,500 has been expended in development work. This claim has been bonded for $20,000. Ten men have been continuously working, and a trail has been built to connect with the waggon road, and ore will be shipped during the coming winter.

London.—A 50-foot tunnel has been driven, which shows in the face a 6-inch body of exceptionally high grade ore.

Lucky Boy.—About $2,000 has been expended in tunnels, etc., and considerable ore is on the dump.

Beaver.—A 70-foot tunnel has been run on the ledge, and a large body of copper and dry ore has been exposed. A good trail has been also built from this claim to connect with the Kaslo waggon road.

Northern Belle.—About $9,000 has been expended on this claim, and shipments of ore amounting to about 100 tons were made early in the spring.

Surprise.—A shipment of 25 tons has been made from this claim, with good results, and a contract has been let to haul 200 tons of this ore to Kaslo, and shipments will be regularly made as long as the snow is on the summit.

Whitewater and Irene.—On this claim, 6 men have been employed for the past two months, and will continue to work during the winter.

SILVER-LEAD SMELTING.

Dominion Bonus of Fifty Cents per Ton to Canadian Smelters.

(Proceedings of the House of Commons.)

On Tuesday, 9th July, the Hon. Mr. Foster presented his bill to encourage silver-lead smelting in Canada. The provisions of the Bill are as follows :—

An Act to encourage silver-lead smelting.

"HER MAJESTY, by and with the advice and consent of the Senate and House of Commons of Canada, enacts as follows :—

1. To encourage silver-lead smelting in Canada, the Governor in Council, may, subject to the following provisions, authorize the payment of a bounty not exceeding fifty cents per ton, and not exceeding in all one hundred and fifty thousand dollars, on Canadian silver-lead ore smelted in Canada between the first day of July, one thousand eight hundred and ninety-five, and the first day of July, one thousand nine hundred.

2. The said bounty shall not for any one year exceed the sum of thirty thousand dollars : Provided, that the said sum if unexpended, or any balance thereof unexpended, may be carried forward from year to year and may be paid for any year in addition to the sum of thirty thousand dollars authorized as above for such year.

3. If in any year the quantity of ore smelted is greater than will allow of the payment, out of the sum available for that year, of fifty cents per ton, then the bounty per ton for that year shall be reduced proportionately.

4. The said bounty shall not be paid on any ores smelted in smelting works which are not established and in operation before the first day of January, one thousand eight hundred and ninety-seven.

5. The payment of the said bounty shall be under the direction of the Minister of Trade and Commerce, subject to such regulations as are made by the Governor in Council.

6. The Governor in Council may make regulations in relation to the said bounty in order to prevent fraud and to insure the good effect of this Act.

7. The said regulations shall be laid before Parliament within the first fifteen days of each session, with a statement of the money expended in payment of the said bounty, and of the persons to whom they were paid, and the places where the ore with respect to which they were paid was smelted, and such other particulars as tend to show the effect of the said bounty.

MR. FOSTER—This resolution pretty well explains its object. The proposition is to encourage and extend the industry of silver-lead smelting in Canada, the principal region in which the industry bids fair to be developed being in British Columbia. The proposition is simply this, that the sum of $150,000 shall be appropriated, to extend over a period of five years ; that for the first year, for instance, not more than one-fifth of the sum shall be paid out ; that the payments shall be made upon each ton of ore which is smelted ; that the maximum paid for each ton of ore which is smelted shall be 50 cents ; that if more than sufficient is smelted at the rate of 50 cents per ton to make the $30,000, the maximum that can be paid out, then the rate per ton will be made by dividing the number of tons that are smelted into the $30,000, or the amount that can be made for the first year. If, during the first year, the $30,000 is not absorbed, any surplus which is left goes on to the second and succeeding year ; but at no time can more than 50 cents per ton be paid for the smelting of these ores. The ores are found in more or less abundance through all parts of the mountain ranges of British Columbia. In the districts along the rivers from the southern boundary north of the line of railway, these ores have been prospected to a certain extent, and have been mined to a certain extent. But, up to the present time, they have all been exported for smelting, consequently, in the first place, the increase in the development of the industry must be retarded by the distance that these ores have to be transported in order to get them to the smelting furnaces which are in the United States. But a greater disadvantage than that is, that only a certain class of ores will bear the transportation and pay the expense, that is, the higher grade ores. As the higher grade ores form a small proportion, necessarily, of all the ores available, it leaves the low grade ores practically unused, although they are of considerable value, and pay largely for smelting, if the transportation to the smelting furnaces for separating the ores does not cost too much. In the smelting of these ores I am told that it is necessary to have two kinds ; besides the common ores, they also need, in order to make up a composition for successful smelting, the dry silicious ores. These are not found in great abundance in British Columbia at the present time, although the prospectors have an idea that they exist, and any stimulus given to the smelting industry will, of course, provoke a search for, and it is hoped, a discovery of, those silicious ores in sufficient abundance to make what is so very requisite in the composition for successful smelting. The object the Government have in view is to give an impetus to the mining and smelting industry of that country, particularly, and wherever ores of that kind are found in Canada, for a limited period. It is not proposed, and it is not thought that it will be necessary, to give aid for any lengthy period. The main idea is to get the industry started, to set the prospectors at work, especially for these dry silicious ores, and so to stimulate the search for, and, consequently the development of, the mining of those ores. It is believed that a very great benefit will result. The labor employed, and the expenses of smelting are large. A certain amount of labor, of course, is employed in mining the ores, and, taking away that high-grade portion of them which stands transportation, but that is not at all to be compared with the labor which is expended on all the adjuncts to the smelting which are necessary, and the expenditures that are made, if the ores, both high and low grade, are smelted in the country. For instancee, in smelting 150 tons of ore, it is calculated that 500 tons of coal are used, that about 1,200 tons of coke are used, and about 500 tons of limestone. Now, all these industries will be stimulated by the smelting of the ore. The coke will be made, probably, at Nanaimo, and perhaps in the Rocky Mountains, and an industry will be developed there which does not, at the present time, exist, giving employment and making large expenditure as well. And so, with reference to the limestone and the coal. Then again, as is well known, the development of the mining industry has a particularly good effect on the consumption of agricultural products. A mining population is particularly a consuming population. It makes nothing for its own wear and for its own food, but it calls lavishly and constantly for the products of the manufacturer, and more especially for the products of the agriculturist. The effect has been seen in the history of this kind of mining in the western and north-western states, where lead smelting has been very greatly developed, and where the combined products of the smelting ores, and of agriculture, largely for the sustenance of the miners, have run up very largely, and now amounts to a very large sum. The amount that Parliament is asked to vote will be but small, the time will be limited, and it is not thought that a period longer than five years will be necessary in order to put the industry upon that basis of development upon which it can go on and extend itself. Certain conditions will be put about it. In the first place, the subsidy begins on the passing of the Act, and extends for five years, and a provision will be put in the Act by which any smelter, to have the advantage of this bounty, must commence these operations by the 1st July, 1896. The object is to give a stimulus to the development at once, to get capital to go in and set up establishments there, and commence operations, so as to give the benefits that are derived from a large industry. All this, of course, will be under regulations of the Governor in Council, as to conditions, supervision, and the like of that. I think these are the main features of the bill which it is proposed to found on the resolution. I may also state that the amount of 50 cents per ton, of course, is but a small percentage of the value. Probably the average value of product would be $50 or $60 per ton, and the aid would be somewhere in the region of 10 cents.

MR. LAURIER—Everybody, I think, including the Minister himself, may have some doubts as to the wisdom of the proposition he now introduces.

MR. FOSTER—I have none.

MR. LAURIER—I have. But for all that I am not disposed to criticise or oppose the motion submitted by the hon. gentleman. I take it that this is to be an experiment, and I should be glad to find that the results which the hon. gentleman anticipates materializes in the glowing figures which he has presented. I have my doubts as to that ; the hon. gentleman has not. But he should have some, because he knows that at the present time silver all over the world is very much depressed, in fact, silver has ceased to become a commodity, and it is now an article to be avoided. The silver market of the United States was never so low as it is now, and I doubt if the aid which the hon. gentleman intends to give the mining and smelting industry of silver will have the results he looks for. However, for my part I would be very glad to know, whether in one year or in five years, that the market has improved, and therefore the results which the hon. gentleman predicts have been realized. If the amount asked from Parliament were a very large figure, in the present condition of the finances, I would, perhaps, be disposed to take a different view from that which I entertain at the present time ; but as the amount is not large, as it is an experiment, and as mining in British Columbia is the principal industry of that province, and is one which we shall all be glad to see developed, I do not intend to offer any opposition to the proposition of the hon. gentleman. The Kootenay district, I suppose, will be that principally affected, and this industry is progressing and developing there, and from that consideration I will allow the motion to pass without offering any opposition.

MR. MARA—I am afraid that the words used here, "silver lead," will exclude some of the ores that it is desired to assist as well as silver-lead. For instance, in the Toad Mountain district, in Kootenay, the ores are silver and copper. Then, again, in the Trail Creek district, the ores are gold and iron. With the clause as it now reads, I am afraid that these ores would be excluded, whereas I think it is not the intention of the government to exclude any ores that are smelted within the Dominion.

MR. FOSTER—With reference to that, I have taken what information I could get from experts, and according to that information, the signification put on the word "smelting" would take in all the classes of ores that ought really to be included under the encouragement given to this industry. They will not take in any ores which are not fit for smelting, such as those which are produced by other processes outside of the real smelting process ; but this will take in the very ores in that district of which the hon. gentleman has spoken.

MR. MARA—The leader of the House is correct, if these ores were all smelted together. The Slocan ores are argentiferous galena, the Toad Mountain ores carry silver and copper, and the Trail Creek carry gold and iron. If all were smelted they would come within the clause under the head of silver-lead ores; but if treated separately at each different mining camp, I am afraid that the clause as it now stands will not cover them. That is the point I want to be distinctly understood. It will take a little time to frame an amendment to cover the point.

Mr. FOSTER—This will take in the ores that we want to take in, those for which the bounty is to be given, namely, silver-lead smelting ores. It includes all the lead ores, all that class of dry silicious ores of which I spoke the other day; it will also take in the sulphides which are found in the district referred to. The ores there I am told carry a small proportion of copper, but the copper in the smelting is recovered as a side product. What we particularly want to do is to encourage the industry of lead smelting, the production of lead bullion, and the information I have is that this term will include those ores.

Mr. MILLS (Bothwell)—The usual galena ores?

Mr. FOSTER—Yes. We can pass the Bill through Committee and defer the third reading.

Mr. MASSON—Is this ton to be weighed as the ore goes in or comes out?

Mr. FOSTER—It is a ton of ore.

Mr. CHARLTON—Is it a long ton or two thousand pounds.

Mr. FOSTER—Two thousand pounds.

Bill reported.

Canadian Companies

Horsefly Hydraulic Mining Co. Ltd.—Reports from Horse Fly, up to the 8th instant, say that hydraulic operations are going on satisfactorily, the gravel showing up well. The company is driving more drifts in order to put in blasts and loosen up the gravel. The ditch is in excellent condition, and altogether the enterprise is in a very satisfactory state. The extensive operations of this and the Cariboo company have put an entirely new life into the affairs of that section of the country.

Cariboo Hydraulic Mining Co.—Advices from Quesnelle to June 7th, state that the past week had been very dry, and the water supply had been reduced to 250 miners' inches, which made it possible only to run 3 hours daily, with the head necessary to operate the monitors. The company had 545 men at work on the ditch from Hazeltine to Polley's Lake, and good progress was being made. It will, however, possibly be well on in July before the work is finished and the full and continuous supply of water secured.

The Montreal Hydraulic Mining Co. of Cariboo, Ltd.—This company, which has large hydraulic claims on the Quesnelle river, is pushing on exploration work. By the close of this month it expects to complete these preliminary operations, except the work of driving the tunnel (which is about 150 feet below the top of the bank), about 300 feet farther. By that time it will have the shafts down to the level of the tunnel. The latter has effectually drained the shafts and the company has had no trouble with water this season. The gravel which has been gone through in the shafts and tunnel has proved to be even richer than that taken out at the commencement of the work, and the company is satisfied that the property will pay handsomely when it can begin hydraulic operations. Work is going on continuously on the three-shift plan.

The Columbian Hydraulic Gold Mining Co. at Hill's Bar is engaged in laying its line of pipes for a distance of half-a-mile from the point of its water supply to the head of the bar, which yielded so much gold in the days of '58 and '59. The company expects to be ready to commence washing dirt some time in July. It will follow the old plan of working, as it believes that using the large head of water from a powerful monitor is the reason why so much fine gold has been lost on some of the claims on the Fraser river, the working of which has caused so much disappointment during the last year or two.

Van Winkle Hydraulic Mining Co. Ltd.—There was a clean-up on the Van Winkle claim, above Lytton, about two weeks ago. As a result of about a ten days' run, the clean-up was a little more than $400. The clean-up was made to test the efficiency of the sluices, and it was found that they were not in a proper condition to retain all the gold. The work is again going on, and it is now thought that the results will be satisfactory. There has been a large expenditure on this plant, and it is to be hoped that the results of operation will be remunerative to the company.

Horsefly Gold Mining Co. Ltd.—In the Horsefly Gold Mining Co. (Foreign) vs. Whipple and others, application was made by Mr. Lindley Crease before Mr. Justice Drake yesterday for a writ of attachment against defendants Kelly, McCallum and Shaw, for disobeying the injunction granted to plaintiffs to restrain all defendants from gold mining on the property claimed by plaintiffs at Horsefly creek. Mr. A. L. Belyea contra. An order was made for writs to issue in one week unless cause was shown to the contrary before the expiration of that time.

Oxford Mining Co. Ltd.—This company is applying for incorporation under Nova Scotia statutes to carry on the business of mining in that province. Authorized capital, $50,000, in shares of $100. Chief place of business is to be at the Oxford gold mines, Lake Catcha district, Halifax county, Nova Scotia. The directors of the new company are to be: E. J. Partington, C. E. Willis and W. H. Covert.

The Cinnabar Mining Company of British Columbia, Ltd., has been incorporated under British Columbia laws, to acquire from F. C. Innes four mineral claims on the north shore of Kamloops lake, near Copper creek, in the Kamloops division of Yale district, known as the "Rose Bush," "Lake View," "Yellow Jacket" and "Blue Bird," and to carry on the business of miners. Authorized capital: $100,000, in shares of $1. Head office: Vancouver. Directors: R. G. Tatlow, A. Graham Ferguson and C. O. Wickenden.

Kamloops Mining and Development Co. Ltd., has been incorporated with an authorized capital of $30,000, in 300 shares of $100, and headquarters at Kamloops, B.C. Directors: Harold E. Forster, C. C. Woodhouse, F. M. Wells and Harry Symons.

Robert E. Lee Mining Co. Ltd.—Registered 28th June, 1895, under the Foreign Companies' Act, B.C., with an authorized capital of $500,000 and headquarters at Spokane, Wash.

Boundary Creek Mining Co., Ltd., has been registered at Victoria, B.C., 28th June, with an authorized capital of $1,000,000, to carry on mining in the Province of British Columbia. Head office: Spokane, Wash.

Idaho Gold Mining and Smelting Co., Ltd.—Registered at Victoria, B.C., with an authorized capital of $500,000, and headquarters in the city of Butte, Montana, U.S.A. Formed to carry on a general mining, smelting, milling and reduction business, and particularly to carry on and conduct such business in Trail Creek Division of West Kootenay Mining District, British Columbia and vicinity, and also more particularly to mine and develop that certain mineral claim in said Trail Creek division of West Kootenay Mining District, British Columbia, known and called the Idaho Mineral Claim, and to reduce the ores extracted therefrom by concentration, smelting, milling and other processes; also to hold, own, purchase, lease, bond or otherwise acquire mining property or other property necessary to carry on the business of the said Company; also to purchase, sell, or in anywise to acquire or dispose of ores for the purpose of carrying on and conducting a general custom business in the reduction of ores of all kinds.

Centre Star Mining and Smelting Co., Ltd.—Registered at Victoria, B.C. 16th July, with an authorized capital of $500,000, and headquarters at Butte City, Montana. Formed to carry on and conduct a general mining, smelting, milling and reduction business, and particularly to carry on and conduct such business in Trail Creek Division of West Kootenay Mining District, in British Columbia, and vicinity, and also more particularly to mine and develop that certain mineral claim in said Trail Creek Division of West Kootenay Mining District, British Columbia, known and called the Centre Star Mineral Claim, and to reduce the ores extracted therefrom by concentration, smelting, milling, and other processes; also to hold, own, purchase, lease, bond, or otherwise acquire mining property or other property necessary to carry on the business of the said Company; also to purchase, sell, or in anywise to acquire or dispose of ores for the purpose of carrying on and conducting a general custom business in the reduction of ores of all kinds.

Eureka Consolidated Mining Company, Ltd.—Registered under the Foreign Companies Act, B.C., at Victoria, 28th June, with an authorized capital of $500,000. Head office: Spokane, Wash.

Provincial Natural Gas and Fuel Co. of Ontario, Ltd.—Supplementary letters patent have been granted, reducing the capital stock of this company from $600,000 to the sum of $510,000; also reducing the amount of each share from $100 to $85.

War Eagle Mining Company.—This company has ordered a 20-drill Rand compressor for its mine at Trail Creek. The plant is said to cost $10,500 laid down, and consists of a compound Corliss condensing engine, with air cylinders 18 x 30. Its weight is 70,000 pounds and two 75-horse power boilers will be required to run it. The War Eagle is now taking compressed air from the Le Roi, but the latter company finds itself unable to continue the arrangement.

Horsefly Hydraulic Gold Mining Co.—Latest advices respecting this company's operations in the Cariboo district state: The clean-up has been continued, and was completed on the 13th inst. The period during which hydraulic operations were conducted was 23 days. The clean-up has produced 781 ounces of gold, of the value of $13,350. The manager writes that the result was fully as good as could be expected in proportion to what was recovered from the sluices, the limited area of ground worked, and the cemented character of the portion of the gravel overlying the powder drift. Although the effect of the blasts which were fired was to loosen up the cement very considerably, yet the extraordinarily tenacious character of this cemented cap (varying in thickness from one foot to seven feet) made the work very tedious and unsatisfactory, while the comparatively barren nature of that deposit made the results not as profitable as they would have been in fair average gravel. Under the circumstances an average result of nearly $600 a day cannot be considered discouraging. Mr. Hobson writes that he has as great confidence in the property as ever as to the ultimate returns and we have seen or heard of nothing so far that would cause us to change the opinion we expressed several months ago in respect to this and the Cariboo Company's property. It is unfortunate that ridiculously extravagant reports should have been circulated by outside parties without any authority or authentic knowledge. To develop a large property like that owned by either of these companies requires the expenditure of both time and money and the results of the early operations cannot be considered as a proof of the richness of the ground, especially when under such conditions as have prevailed on the Horsefly claim. The last advices from the Horsefly mine report that No. 2 pit was running steadily, and that operations would be resumed almost immediately in No. 1 pit with four giants. By this time, therefore, it may be assumed that work is again in full blast, with everything in shape for a steady run.

Cariboo Hydraulic Mining Co.—Advices from Cariboo district up to the 14th ultimo report that operations at the Cariboo Hydraulic Mining Company's claims are suspended owing to the scarcity of water. The season up there has been drier and hotter than for several years past, and California miners say it has been much drier than is often the case in that State. As a comparison between this and previous seasons, it may be stated that from observations taken, there was, in the season of 1892, water running sufficient to fill two such ditches as supply the monitors of the Cariboo Company; in 1893 there were about 1,500 inches, while in 1894, although a dry season, there was considerably more water than there has been this year. However, the work on the ditch from Polley's lake is now well advanced, and it is likely to be completed by the first week in August. Then there will be a constant supply of at least 2,000 inches, and operations will go on uninterruptedly, whatever the character of the season.

Nelson Hydraulic Mining Co., Ltd.—This company reports a partial clean-up with satisfactory results. The run is stated to have been for only 120 hours and the gold secured is valued at from $4,000 to $5,000, although the exact sum is not known. A letter from Nelson says that there is "on view in the Bank of British Columbia there, a good-sized bowl half full of gold, a gold brick of the value of $2,000, a smaller brick, and a $50 nugget. This represents the gold picked off the bedrock in front of the boxes, and the contents of the first two or three boxes themselves."

The company has now got through most of the barren ground, large boulders, etc., and will now have much richer gravel upon which to work. As there is still abundance of water available another good clean-up may be expected before the close of the season. The expenditure on the property to date has not exceeded $20,000.

Hall Mines, Ltd.—It is reported that this company has accepted the bid of the California Wire Works for the erection of an ærial tramway from the Silver King mine to Nelson.

Danville Slate and Asbestos Co.—Mining is being vigorously proceeded with on this company's properties, more particularly at the Jeffrey Asbestos mine, where a strong force of miners are employed. A large new mill-building equipped with a first class plant, including a number of cyclone pulverizers, and 500 h.p. engine furnished by the Laurie Engine Co. of Montreal, is rapidly nearing completion. The management report the cyclone mill a great success.

War Eagle Mining Co—The remarkable results being obtained by this company's gold mine in the Trail Creek district is attracting attention. To date the claim has been opened by tunnels, winzes, and air shafts. Work, however, has been confined to two of these veins, while the principal workings from which the ore has been taken are on one vein only. The development work up to now consists of a tunnel over 650 feet long, and a second tunnel 350 feet long. There are also three shafts from the surface, one of them being sunk considerably in advance of the face of the 650 feet tunnel. This shaft is down now about 80 feet. The vein, before reaching the spot where this shaft is being sunk, appears to be split, although each of the parallel veins which have been exposed by open cuts are of about the same width and inclination as the single vein. At the surface the ore in this shaft is about eight feet wide while at the depth to which the shaft is now sunk the vein is nearly twelve feet wide. The ore in this shaft is the highest grade of any yet struck, while it gets better with depth. The lower tunnel was started at the east end of the mine and is now in about 350 feet. Above this tunnel, at a height of 120 feet, another has been run. This was started considerably west of the lower tunnel, and has been driven for about 650 feet. The uprise from this tunnel is 110 feet, and it is from here that the chief quantity of the ore has been taken. Some stoping is now being done there. There are now good reserves of ore and the dividends already commenced to be paid to the shareholders are, therefore, likely to be regularly maintained. The last paid was at the rate of 10 per cent., or $50,000. This barely represented the profits actually realized in three months. So far no expensive hoisting or pumping machinery has been required, and from all appearances this expenditure will not be necessary for some time. The location of the War Eagle was made in July, 1890, by Messrs. J. Morris and J. Bourgeois. After some vicissitudes the property was bonded in April, 1894, by Patrick Clark, of Spokane, for himself and others, for $20,000. Immediately after this bond was given the War Eagle Mining Company was organized with a capital stock of $500,000 and work was prosecuted with the vigor usually shown by such men as Clark, Finch and Kingsbury. James Clark, who has been identified with some of the best developed mines in the Cœur d'Alenes and elsewhere, was secured as superintendent, while his brother, Patrick Clark, was made manager with headquarters in Spokane, where the head office of the company is located. Since that time work has gone on steadily and the mine has produced enough ore, which has netted $30 and over per ton, to pay two handsome dividends, dividend No. 1 being for $32,000 and No. 2 for $50,000. Sixty-five men find employment in and about the mine and 20 teams are kept busy hauling the ore to the railroad, the output at this time being 65 tons daily. The ore reserves in the War Eagle are sufficient to promise another dividend soon, and from present indications it is probable others will follow at regular and frequent intervals.

Black Jack Mining Co.—It is reported that the property of this company, including the reduction works at Rat Portage, Ont., has been sold to a company of French and English capitalists.

LEGAL.

The Judgment in Capt. Adams' Suits,—Moses Ediams et al. and W. H. Brandon et al.

The following is a certified copy of the judgment in the celebrated "Bon Ton" suits, the mineral property owned by Captain Adams, of Montreal:—

"I certify that this action was tried before His Honor Judge Spinks, with a jury, of the county of Kootenay, on the 20th day of April, A.D. 1895.

"The jury found:

"1. Have the defendants *knowingly and falsely represented* that the recorder made a mistake in recording the claim in order to obtain a certificate of improvements to ground to which they had no right?—No.

"2. Did the defendants *wilfully* state that they had expended money on the claim that they knew they had no right to take credit for?—No.

"3. Did the defendants, *for the purpose of deceiving*, put in an advertisement not correct?—No.

"4. Whole question?—No.

"5. Was the certificate of improvements obtained by fraud?—No.

"The trial judge directed that judgment should be entered for the said defendants with costs.

"Dated this 22nd day of April, A.D. 1895.

"(Signed) T. H. Giffin,

"Registrar of the County Court of Kootenay, holden at Nelson."

Verdict of Interest to British Columbia Miners.

At the sitting of the County Court, Nelson, B.C., Judge Spinks gave judgment in the "Early Bird" case as follows:—

"The facts of the case are undisputed and very shortly stated. The defendant located and recorded a mineral claim, he did the required assessment work, but did not record the assessment work until the anniversary of the date of the record.

"It is contended by the plaintiff that the recording of the assessment work was not done within the first year of the defendant's holding of the claim and that therefore he had forfeited all rights under his record.

"Sec. 24 of the Mineral Act, 1891, reads as follows: Any free miner having duly located and recorded a mineral claim, shall be entitled to hold the same for the period of one year from the recording of the same, and thence from year to year. Provided, however, that during each year and each succeeding year, such free miner shall do, or cause to be done, work on the claim itself to the value of one hundred dollars, and shall satisfy the Gold Commissioner or Mining Recorder that such work has been done by an affidavit of the free miner, or his agent, setting out a detailed statement of such work, and shall obtain from such Gold Commissioner or Mining Recorder, and shall record, a certificate of such work having been done.

"This section has been slightly altered, but not so as to affect the point at issue.

"Sec. 34 also sets out the interest a free miner has in his claim and reads as follows: The interest of a free miner in his mineral claim shall, save as to claims held as real estate, be deemed to be a chattel interest, equivalent to a lease, for one year, and thence from year to year, subject to the performance and observance of all the terms and conditions of this Act.

"The question therefore settles itself down to this: when does the first year of a tenancy expire? This seems to have been settled by the case of Ackland vs. Lutley, 9 A. & E. 879, in which Lord Denman says, 'The general understanding is that terms for years last during the whole anniversary of the day from which they are granted.' This case was followed in the Ontario case of McCallum vs. Snyder. 10 C. P. 191.

"My judgment therefore is, that the first year of the free miner's tenancy, which, we have seen, is declared by the Mineral Act to be equivalent to a tenancy from year to year, does not expire until the end of the anniversary of the date of the record, and therefore that the certificate of work being recorded on such anniversary was recorded in time to prevent a forfeiture."

MISCELLANEA

Winding Ropes in Deep Belgian Collieries—Messrs. A. Harmegnies Brothers, of Dour, Belgium, have manufactured flat drawing ropes for new deep winnings in the Mons and Charleroi districts. The largest of these, made for the Sainte Henriette, or No. 18 pit of the Societe des Produits at Flenu, are intended to lift a load of 6½ tons, made up of 3½ tons weight of cage and six tubs and three tons net load of coal, from a depth of 1,200 metres (3937 feet). They are made of Manilly aloe fibre of a flat section, with 10 strands tapering in breadth from 420 millimetres at the large end to 220 millimetres at the small end, and in thickness from 49 to 29 millimetres. The average weight per metre is 11 kilograms, giving for the length of 1,350 metres a weight of 14,85 tons for each rope. The working strain will be 90 kilograms per square centimetre at the thick and 110 kilograms at the thin end. These are the first 10-stranded ropes that have been made in aloe fibre. The winding engines constructed in the shops of the Societe des Produits have cylinders 1,100 millimeters in diameter and 2,000 millimeters stroke, and are intended to be worked with steam at four atmospheres boiler pressure, bringing the load from the bottom of the mine to the bank in 65.4 revolutions, the radius of effort on the rope reels varying from 1.62 metre empty to 4.22 metres when filled. The moment of the load varies from 17.166 kilograms at starting to 405 kilograms on the arrival of the cage at bank. The steam consumption will be 248.52 cubic metres, of 465 kilograms per journey. The working life of the ropes will be about 24 months. Flat steel ropes by the same makers are in use at the Providence pit at Marchiennes au Pont near Charleroi. These are made of eight parallel four-stranded ropes tapered by reducing the number of wires in the strand from 12 to 11 and 10, according to position, the diameter of the wire, which is of crucible cast steel, of a tensile strength of 89 tons per square inch, being kept constant at two millimetres throughout. The breadth of the rope varies from 200 millimetres at the thick to 170 at the thin end, and the average weight is 12.25 kilograms per metre. The winding engines of 2,000 horse power are similar in dimensions to those noticed above, and draw a gross load—12½ tons; 6½ tons for the cage and 12 tubs and 6 tons of coal—from a depth of 950 metres (3117 feet). Owing to the small diameter of the shaft only single tub decks can be used in these collieries so that 10 and 12 deck cages are required in order to be able to command a large output during the shift while running the engines at a proper working speed. The life of the ropes is about 12 months

The Supply and Consumption of Oil.—The *Engineering News* of April 25th remarks in an editorial that the recent sudden jump in prices of crude oil appears, from all statistics available, to be likely to mark a permanent change, and one of no small moment from an engineering point of view. The production of oil has kept in advance of consumption for so many years through the constant opening of new fields that people have grown oblivious to the fact that an end must come to the supply of this valuable product, and that this end could not long be postponed if the world went on using up the supply at such a prodigal rate as it has been doing in the past dozen years. The advance in price has greatly stimulated the prospecting for new territory, and has caused the reopening of many abandoned wells of small production; but the total increase in production thus far secured seems to be small. An advance in the price of refined illuminating oil is probably inevitable. Notwithstanding the increased price of crude oil, the use of oil for fuel does not seem likely to be materially interfered with for some time to come.

The Possibilities of Electrical Pumping Machinery.*

By Chas. A. Hague.

The pumping of water by means of the power derived from the electric current has, as many are aware, already been accomplished upon a limited scale.

The convenience and controllability of electrical power, together with its simplicity of application to the work of pumping, commends it very strongly for use in isolated places, such as high-service systems in public water supply, wherein a comparatively small percentage of the total water supplied by the initial plant is needed for dwellings situated upon levels too high to be accommodated by the general pressure; and the question, of course, arises whether we shall put the entire system of the city under the highest pressure required to force a supply to these higher levels, thereby placing a large portion of the mains and fixtures under an unnecessary strain, while operating under wasteful conditions of pumping power; or whether we shall isolate the higher levels and handle the smaller percentage of water by itself.

The application of electrical energy to the pumping of the main supply of a city of considerable size, although presenting many attractive features as far as the actual operation of the pumps is concerned, is not yet within the possibilities on account of the absence of inexpensive methods for producing the necessary current; so that apparently, in pumping large quantities for some time to come, the compound, the triple, and the quadruple steam pumping engine will hold their sway. To-day it is beginning to offset very forcibly the proposition that it does not pay, in the present state of perfection of the steam engine, to go very far out of the way of regular commerce, to get the cheap power afforded by a falling stream.

To bring the problem of high service pumping down to figures and familiar terms, supposing that a city's total supply is 10,000,000 gals. per day, and only 1,000,000 gals. are needed for a district which would make it necessary to deliver its supply under a pressure of 125 lb. per square inch if delivered from the main pumping station; while the remaining 9,000,000 only needed a pressure of 75 lb. for distribution. Then the difference in power would be as follows: The entire 10,000,000 gals. under the 125 lb. pressure represents 500 horse power, while the 9,000,000 under 75 lb. pressure represents only 270 horse power; and the 1,000,000 under the high service pressure of 125 lb. represents only 20 horse power. The economy of power then would be $500-(270 \times 20)=210$ horse power saved by dividing the service.

How convenient it would be to generate an electric current at the main pumping station, with the boiler plant used for pumping the main water supply, then run the wires up to a point adapted to the high service pumpage and operate an electrically driven pump. Of course a high service steam pumping plant could be installed at the proper point, but that would mean expensive attendance, hauling of coal, ashes, and supplies; and last, although by no means least, large quantities of smoke and dust dispensed broadcast over what is generally a residence district. There are cities wherein pumping plants are supplied with anthracite coal at double the cost of bituminous coal, to quiet the complaints of dwellers and the owners of lawns and trees.

Glance for a moment at the saving in fuel shown by dividing the service as set forth above. The case supposed is extreme, but extremes illustrate forcibly, and there probably cases in actual practice the full equal of the one supposed. Allowing that an economic duty of 1,000,000,000 is obtained at the pumping station, or say 2 lb. of coal per horse-power hour, then the 210-horse power saved represents $5,475 per annum, which would pay 5 per cent. interest upon $109,500.

Even if it should not be desirable to install an electric generating plant at the main pumping station, power could often be obtained from street railways, or lighting plants already in existence in many cities. When we consider the inconvenience and cost of sometimes providing mains for different districts, simply to convey the water supply from a central high-service pumping station, the possibility of a small electrical station for each district begins to hint at the economy in first cost and maintenance of such an electrical system.

The method of switching on and off the electric current by means of the water-level or pressure is one of the details that will occur to the hydro-electrical engineer. In using the term hydro-electrical engineer, I simply follow the tendency to specialize which has taken strong hold upon modern science and practice. At the start, the hydraulic engineer thought that there was nothing to do but harness up the electric dynamo and motor to a pump, and the task was accomplished of pumping by electricity. The electric engineers imagined there was nothing to do but harness up a pump to his motor, and behold the result was obtained. But after a few attempts it was discovered that the pump handling such a stubborn and inelastic element as water was subject to inertia, shock, and variable power within short limits, quite at variance with the steady uniform operation desirable for the best electrical results. The pump man turned his attention to securing a steadier flow of water, while the electrical man was, apparently, inclined to adopt the convenient but wasteful methods involved in the process of wasting power instead of controlling it. Hence the "hydro-electric" engineer, whose office is to reconcile the extremes of the case into the most benefit to all concerned, precisely in effect as the modern steam pumping-engine designer has evolved a machine which, operated by a highly-elastic fluid at one end, smoothly delivers an obstinate unyielding fluid at the other.

If the steam pumping-engine taking steam from the boiler at a pressure of 150 lb., and sending this steam to the condenser at a pressure 8 lb. below the atmosphere, can deliver without shock, and with a fairly close approach to theoretical economy, a steady stream of water, there is every reason to believe that the "hydro-electrical" engineer will eventually be able to bring the items of short circuiting, resistances, ampères, and volts into a reasonably close approximation to the results demanded.

* Abstract of a paper read before the Atlanta meeting of the American Waterworks Association, May 28-30, 1895.

Cannel Coal as an Enricher.—The *Progressive Age* of April 15th has an article on this subject by Graham Macfarlane. In view of the strong competition of petroleum products, any cannel coal which does not yield a coke which is of some value to the gas-works is shut out from general use by gas companies, except such as are in the immediate neighborhood of the mines producing such cannel. As to how cannel coal was deposited there have been various ingenious theories proposed. Having professionally examined nearly all of our American cannel mines, the author was inclined to the belief that cannel coal was derived from a highly resinous vegetation, either distinct from that from which came ordinary bituminous coal, or more likely the lighter and more resinous part of the general forest of the carboniferous age, which in a gelatinous condition was finally deposited either in little separate seams, or as a part of the many bituminous seams. In almost every instance the cannel coal seams are extremely sporadic and treacherous, and now, with the lower prices forced by oil competition, the lot of the cannel coal operator is not a happy one. Most towns use cannel coal as an enricher.

Coal Washing Plant, Powell Duffryn Company's Elliot Pits.—The *Engineer* of May 3rd describes and illustrates the coal washing plant at the Powell Duffryn Steam Coal Company's Elliot Pit, Aberaman, near Aberdare, South Wales, and erected in the years 1891-92 by the makers, the Humboldt Engineering Works Company. This "washery" is intended to wash provisionally 350 tons, and later 500 tons of nuts and small coal, including dust, per day of nine hours, and to reduce the whole quantity, or only part of it, to the necessary size for making first-class coke. The above-mentioned quantity of coal consists of the screenings from ordinary bar screens with 1½ inch spaces, on which the pit coal is screened, in previously erected screening plant as found in most collieries. In reference to screening and sizing plant a machine, patented by the Humboldt Company, which is used either for breaking anthracite or other coal into nuts of any required size, or for breaking lumps of coal from the picking table, mixed with dirt or shale, to a suitable size for subsequent treatment in the washers, is also illustrated and described. (6 Figs.)

Steel Castings—At a recent meeting of the Manchester Association of Engineers the question of steel castings was introduced by Alfred Saxon, who, after enumerating the infinite variety of purposes for which steel castings were now used, said that for repetition work they would, speaking generally, be better than cast iron or steel forgings. There were certainly difficulties in the machining of steel castings, and in connection with many of them special designing was no doubt necessary. A source of trouble not infrequently was their liability to burst during contraction in cooling, when they were being shrunk on to parts of engines; in these cases he thought, however, the engineer had not carefully studied the nature of the material he had to deal with, and had simply allowed the same amount for shrinkage as he would in a forged iron or steel shaft. In some quarters it was stated that failures and disappointments in steel castings were vastly in excess of those in cast iron. He urged that engineers should insist upon their castings being sent in unpainted. In the use of cast iron they had failures and bad castings, but yet they would never think of discontinuing them; in steel they had a stronger metal, from which almost any form of casting could be produced, and it was their duty to see how they could economically use it in the way of lightening their structures, or where strength was needed without increase of bulk.

Quebec Mining Association Excursions.—A notable feature of the proceedings of the summer meeting of this association at Quebec on 27th and 28th June, was the delightful series of excursions thoughtfully arranged for the entertainment of the members and their friends by the local committee. These included a thoroughly enjoyable calèche drive to the historic sites of the ancient city on the morning of Friday, 28th, at the conclusion of which cake and wine were served in the Union Club. In the afternoon the members and a number of prominent citizens of Quebec were the guests of Messrs. Carrière, Lainé & Company, in the steam yacht "Vega" visiting the Chaudiere Falls, Montmorenci Falls, and the large engineering works of the firm at Levis. Before returning to Quebec, the Hon. E. J. Flynn and his Worship Mayor Villeneuve gracefully acknowledged the courtesy of Messrs. Carrière, Lainé & Co., and congratulated them on the success of their engineering enterprise. Mr. C. H. Carrière, Mr. James King, M.L.A., and Mr. Lawrence Lynch, members of the local committee, were then duly "bounced" to the strains of "They are jolly good fellows." On Saturday many of the members took advantage of the special rates given to the association and visited the Saguenay *via* Lake St. John, while others who could not afford time for so long a journey ran out to Ste. Anne de Beaupré.

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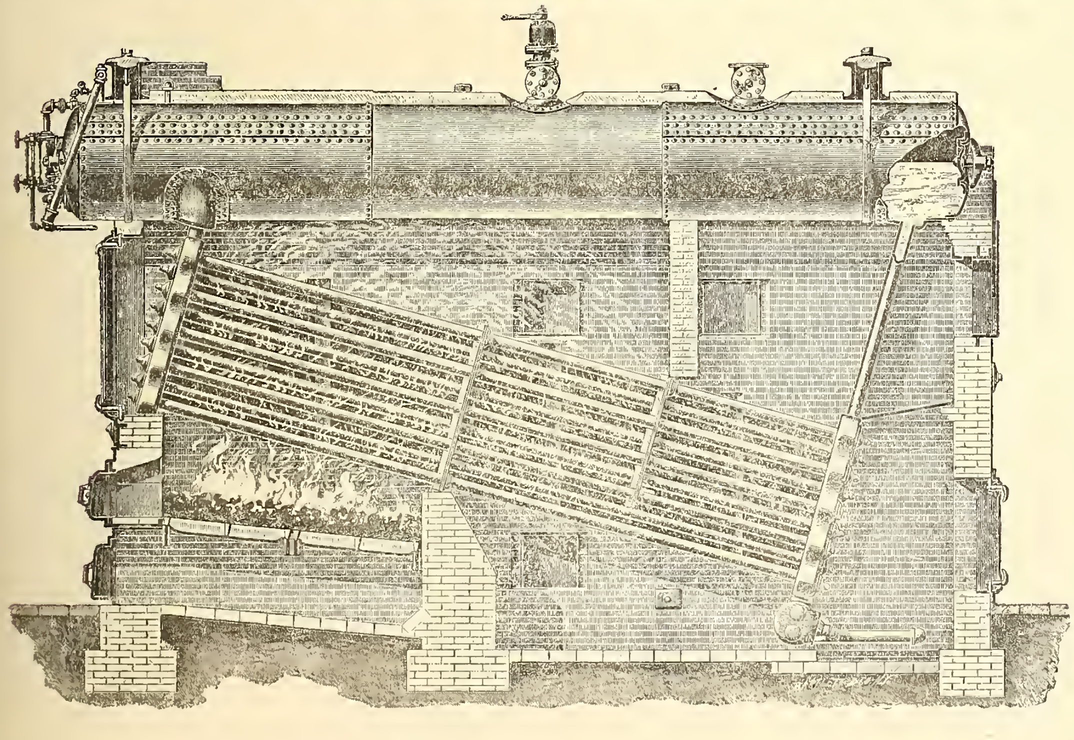

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The Canadian Mining Review

Established 1882

Vol. XIV.—No 8. 1895—OTTAWA, AUGUST—1895. Vol. XIV.—No. 8.

MINING LAWS OF ONTARIO.

ANY person may explore Crown Lands for minerals. Mining lands may be taken up as surveyed locations or staked claims.

Locations range from 40 to 320 acres.

Claims range from 10 to 20 acres on vein or lode.

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Price of locations north of French River, $2 to $3 per acre, and south of it, $2 to $1.50, according to distance from railway.

Rent of locations first year 60c. to $1 per acre, and subsequent years 15c. to 25c. per acre.

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Claims must be worked continuously.

Royalty on ores specified in the Act, 2 per cent. of value at pit's mouth less cost of labor and explosives.

Royalty not charged until seven years from date of patent or lease, nor (as provided in s. 4 (3) of the Mines' Act, 1892), until fifteen years in the case of an original discovery of ore or mineral.

Original discoverer of ore or mineral on claim entitled to stake out a second claim.

Crown Lands sold under provisions of mining laws in force prior to 4th May, 1891, exempt from royalty.

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Director Bureau of Mines

TORONTO, May 25th, 1894.

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OF

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Of the aggregate of costs and charges above enumerated, excepting the sixth item, forty per cent. will be borne by the Bureau of Mines in 1894, thirty-five per cent. in 1895, thirty per cent. in 1896, and twenty-five per cent. in each year thereafter until the end of 1900. All accounts payable monthly.

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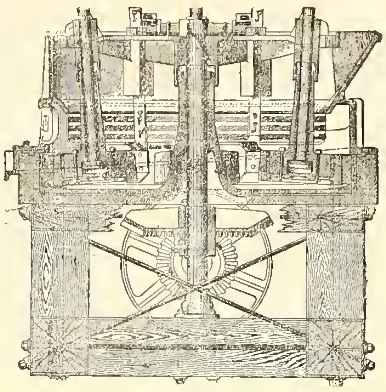
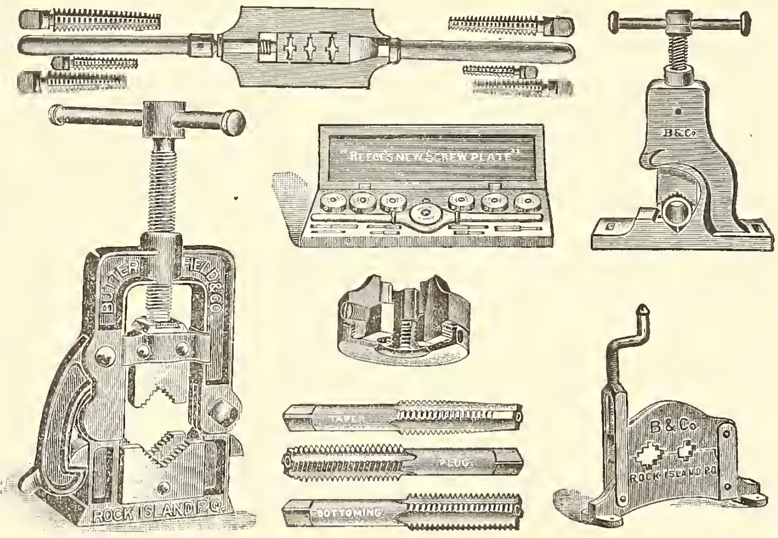
A. S. HARDY,
Commissioner of Crown Lands.

Toronto, October 17, 1894.





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The Canadian Mining Review

Established 1882

Official Organ of The Mining Society of Nova Scotia; The General Mining Association of the Province of Quebec; The Asbestos Club; and the Representative Exponent of the Mineral Industries of Canada.

B. T. A. BELL, Editor. | Published Monthly. | OFFICES: Slater Building, Ottawa.

VOL. XIV., No. 8 | AUGUST, 1895. | VOL. XIV., No. 8

CANADIAN COMPANIES.

Idaho Gold Mining and Smelting Co., Ltd.—Was registered at Victoria, B.C., under the Foreign Companies Act, with headquarters at Butte City, Montana, and a capital of $500,000. The objects of the incorporation are:—To carry on and conduct a general mining, smelting, milling and reduction business, and particularly to carry on and conduct such business in Trail Creek division of West Kootenay mining district, in British Columbia, and vicinity, and also more particularly to mine and develop that certain mineral claim in said Trail Creek division of West Kootenay mining district, British Columbia, known and called the Idaho mineral claim, and to reduce the ores extracted therefrom by concentration, smelting, milling and other processes; also to hold, own, purchase, lease, bond or otherwise acquire mining property or other property necessary to carry on the business of the said company; also to purchase, sell or in anywise to acquire or dispose of ores for the purpose of carrying on and conducting a general custom business in the reduction of ores of all kinds.

Cariboo Hydraulic Mining Co., Ltd.—Mr. John B. Hobson, M.E., in charge of the operations of this company at Quesnelle Forks, B.C., writing under date of 28th ultimo, says: "I intended to write you some mining news, but have had my hands full getting the Horsefly mine opened, besides looking after about 600 men here at the mine and scattered over 17 miles of wilderness through which we are cutting the Cariboo canal to a permanent source of water supply. This canal is 7 feet wide at bottom, 13 feet wide on top and 3 feet deep, and has a capacity for delivering 3,000 miners' inches of water. We calculate to have this canal completed by the 15th of August, when the water will be turned on and discharged through three 18-inch giants with 6-inch nozzles, to wash the gravel from the bank in the China pit of the Cariboo mine. After the water is on a month look out for reports of the biggest gold bar that ever went down the Cariboo road."

Cariboo Reefs Development Co., Ltd.—Was registered at Victoria, B.C., on 7th August, under the Foreign Companies Act, with a capital of £20,000 sterling, to carry on mining operations in the Province of British Columbia.

Lookout Mining and Milling Co., Ltd.—Was registered at Victoria, B.C., on 1st August, with headquarters at Spokane, Wash., and a capital of $250,000, to carry on mining and smelting operations in British Columbia.

Mild Brook Mining and Reduction Co., Ltd., has been incorporated under the laws of New Brunswick, with an authorized capital of $500,000, and headquarters at Moncton, N.B. Directors, G. Barret Latz, Isaac N. Wilhur and Robert M. Dryden. Operations are to be carried on at Mild Brook, in the parish of Alma, Albert County, New Brunswick.

Nova Scotia Coal Mining Co., Ltd., has been incorporated under the laws of Nova Scotia, with an authorized capital of $50,000, in shares of $50 each, for the purpose of acquiring a tract or tracts of coal areas in that province. The incorporators are, C. F. W. Bell, E. Lawrence, W. Macdonald, Truro; A. McKay, Kingston; A. H. Learment, Truro; J. L. Stevens, Kingston; L. B. Crowe, and A. C. McKenzie, of Truro.

Canonto Mica and Mineral Mining Co., Ltd., has been incorporated under Ontario statutes, with an authorized capital of $22,000 in shares of a par value of $44 each, to carry on mining in the Counties of Frontenac, Peterborough, Hastings, Addington, and Lanark, and the chief place of business in the city of Toronto. The property to be acquired includes a lease of mining rights in the township of South Canonto, in the County of Frontenac, dated 17th, April, 1895, made by the crown to C. A. Dade, of Weston, York Co. The directors of the new concern are, George Taylor, Village of Weston; Thos. Pier, Lambton Mills; Arthur Clayton, Lambton Mills; and F. P. Brazill, Toronto.

Van Winkle Consolidated Hydraulic Mining Co., Ltd.—This company had a clean-up recently, the result being about $1,300. The run was for 27 days, and the total quantity of water used is stated to have been 43,822 miners' inches. Of the period mentioned it is, however, stated that 4½ days were used in grading and putting in 240 feet of main sluices, so that the actual for running time was only about 22½ days.

Horsefly Hydraulic Mining Co. Ltd.—Advices from the claims of the Horse Fly Hydraulic Mining Co. state that hydraulic operations have been steadily carried on since our last report, three 8-hour shifts being employed. There was only one short interruption necessitated by the stoppage to extend the branch flumes. There is plenty of water, the ditch running full and everything in good shape. The extension of the flumes, the superintendent writes, "enables us to move the boulders and gravel much quicker than before. So far this last week has seen better progress made than at any time before this season."

Le Roi Mining and Smelting Co. Ltd.—The straightening of the shaft in the Le Roi mine is nearly completed. This work has interfered with the output of ore from the lower levels. The new machinery is in place and will be in operation by this time. By means of it 100 tons of ore can be hoisted easily in 24 hours and the producing capacity of the mine will be largely increased thereby. The company expects to begin delivery of the 75,000 tons of ore, for which they are under contract, about October 1st, next. Some very high assays have been obtained recently from specimens taken from the west drift of the 350 foot level. One sample gave a return of 24½ ounces of gold to the ton.

Kootenay Mining and Smelting Co. Ltd.—The Pilot Bay smelter has started up again, smelting recommencing on the 29th ultimo. It is stated that there is no probability of the smelter being compelled to shut down again soon, as the Skyline mine alone is furnishing enough dry ore to keep it running. An ample supply of wet ores is being received from different points.

Iron Horse Mining and Milling Co. Ltd., was registered at Victoria, B.C., on 10th insiant, under the Foreign Companies' Act, with headquarters at Spokane, Wash., and an authorized capital of $1,000,000, to carry on mining operations in British Columbia.

Crown Point Mining and Milling Co. Ltd., was registered at Victoria, B.C., on 10th instant, with headquarters at Spokane, Wash., and an authorized capital of $1,000,000, to carry on mining in the Province of British Columbia.

Mount Hood Consolidated Mining Co. has heen organized at Spokane, Wash., to take over and work the "Mount Hood," "Only One" and "St. Patrick" mineral claims in the Trail creek district B. C. The officers of the new company are: Lane C. Gilliam, President; F. C. Bellamy, Vice-Pres. and Treasuer; W. W. McCalley, Manager; W. E. Blackmer, Secretary.

Hall Mines, Ltd.—This company is reported to have contracted with Fraser & Chalmers, Chicago, for the construction at Nelson of a 100-ton smelter. The ore bins of the Nelson and of the Silver King tramway are under construction. The receiving bin at the end of the tramway will be 25 feet wide, 40 feet long, and 30 feet deep; below it will be another bin 25 by 30 feet and of the same depth. About 100 feet to the west will be eight bins of a uniform size (25x30x30 feet). The floors of all the bins, except the receiving bin, will be high enough from the ground to allow of a dump-car track being laid under them. The bins will also be so constructed that a railway track can be laid alongside them. Their construction will require over a quarter million feet of timber and lumber. In order to get a secure foundation for the eight bins that are built together, cribbing will have to be put in, in one place 26 feet high. The cribbing will require over 35,000 lineal feet of timber. This timher will be cedar, and it has all been cut on the flat near the tramway line. Hugh Nixon, one of the most experienced millwrights in the country, is in charge of the work. He has 20 men at work, and expects to have 40 when the framing begins. The tramway contractors have about three-quarters of a mile of towers erected.

War Eagle Gold Mining Co.—This company, operating at Trail creek, B.C., has declared another dividend of 10 cents per share, or $50,000, making the third since the first of the year. The first was paid 1st March, and was $32,500; the second on June 15th, $50,000, and now she comes forward again with another $50,000, making a total of $132,500, the profit of seven months' production. A first-class showing indeed, though it does not fully and clearly represent the actual capacity of the mine, as the Customs house squabble in January, and the impassable state of the roads in March and April, materially hindered the output, and again there is a very considerable quantity of ore, both at the smelter and on the way there, for which returns are not yet to hand. This dividend shows the mine up to be a producer that can be relied upon to pay $250,000 a year to its owners, or about eight times its original cost.

The Prospecting Syndicate of British Columbia, Ltd.—This company has been incorporated in British Columbia with an authorized capital of £10,000 in 10,000 shares of £1 each, for the purpose of acquiring gold and other mineral properties in that province. The functions of this company will be not only the acquiring of suitable properties, but the working up of connections with the London market for their disposition. Quoting from the prospectus, we learn: "There will be no charge for promotion money, underwriting, commissions or brokerage in connection with the formation of a company, except a sum of £100, being actual cash out of pocket for lawyers' fees, expenses incurred in England and British Columbia, including registration, and a small commission in case any shares are placed through English brokers, which commission will be payable to them." The directors of the company are Edward Mahon, J. W. McFarland, and Gilbert Mahon, all of Vancouver, B.C. The chief place of business is at 519 Hastings street, Vancouver, the secretary being Mr. T. T. Scott.

Eustis Mining Co.—The annual meeting of this company was held on 15th instant.

Nova Scotia Steel Co., Ltd.—The following is an excerpt of the directors' report submitted at the annual meeting of shareholders this month :—

"The directors, in submitting the first annual report, balance sheet and revenue account for the year ended 30th June, 1895, have satisfaction in reporting that the sale to this company of the franchises, property and assets, of the Nova Scotia Steel and Forge Co., Ltd., and the New Glasgow Iron, Coal and Railway Co., Ltd., as authorized by the shareholders of said companies, at the special general meetings called for that purpose, has been confirmed by Acts of the Dominion and Provincial Legislatures respectively.

The extreme depression of the iron industry, particularly in the United States during the past year, had the effect of reducing prices so much below former years, that profits were greatly decreased.

Owing to the large accumulation of unsold pig iron, and the necessity of a partial relining, the furnace was out of blast during five months of the year.

The output of the steel works was largely curtailed during the month of July, 1894, owing to the cogging mill engines having broken down, involving a large loss through the stoppage of the works, and cost of repairs.

As to the future—prices have improved considerably during the past three months, orders for a large quantity of steel have been received. Pig iron during the past two months is being sold as fast as the blast furnace is producing it, and we enter the new year with very fair prospects.

The aecounts herewith submitted deal with the operation of the amalgamated companies for the twelve months ended 30th June, 1895.

The profits of the year ended 30th June, 1895, were	$ 22,578 35
To this must be added the balance at credit of profit and loss account N. S. Steel and Forge Co., Ltd., 1st July, 1894	3,886 75
Also balance at credit of profit and loss account New Glasgow Iron, Coal and Ry. Co., Ltd., 1st July, 1894	90,814 59
	$117,279 69

Canadian Mica Co., Limited.—This company is vigourously pushing its mica business, operations at present being mainly confined to the Dacey lot in the township of Hull, worked on royalty with option of purchase, and the Murray Bay mine. From both of these properties mica of excellant quality and size is being obtained, the shipments being almost entirely to England. Mr. H. Baumgarten is managing the company's affairs on this side.

Danville Slate and Asbestos Co., Limited.—This company has imported from the Farrell Foundry and Machine Co., Ansonia, Conn., three large rock breakers for their new mill. The sizes are respectively 36 x 24, jaws 8 in. to 7 ; 40 x 10, duplex, jaws 3 to 2½ ; and 40 x 6, jaws, ½ to 1.

Ingersoll on Top.

Coal Cutting Test at Dominion No. 1 Colliery of the Dominion Coal Co., Ltd., C.B.

During the fortnight ending 10th August, '95, a test to ascertain the capacity of the Ingersoll, Yoch and Harrison percussion coal cutting machines was made at the above mine. The conditions were that the machines should work in adjacent rooms, commencing each day at 7 p.m., and ceasing work at 4 a.m. The rooms were 21 ft. in width, and the height of the coal about 7 ft. 6 in. The seam is known as the "Phalen." The trial was organized and carried out under the control of Mr. Wm. Blakemore, the Company's Mining Engineer, and Mr. John Johnston, the manager at Dominion mine. At the end of the fortnight it was found that the Ingersoll machine had achieved the best result, having cut 6,038 square ft., which for 11 full days was equal to 549 ft. per day, and for 97 working hours an average of 62.24 square ft. The Yoch machine was second on the list, having cut 5,929 sq. ft., an average of 539 sq. ft. per day and 59.88 sq. ft. per hour. The Harrison machine cut 4,940 sq. ft., an average of 440 sq. ft. per day and 49.89 sq. ft. per hour. Averaging the work of the three machines we get per day 509 sq. ft., and per hour 57.30 sq. ft. It is hardly necessary to say that this is by far the greatest amount of work which has ever been done with this class of machine in similar hard coal, and shows the absolute efficiency and adaptability of such machines for narrow room work. The total number of tons cut during the fortnight was 4,460, a daily average of more than 400 tons for the three machines. The machines were worked by compressed air, which was maintained at a uniform pressure of 70 to 75 lbs. per sq. inch. Although the Ingersoll and Yoch machines had so nearly the same amount of work the Harrison was a long way behind, but by way of explanation it is only fair to point out that the latter is a much smaller machine, having only a 3 in. piston, while the Ingersoll has a 4 in. and the Yoch 6 in. It may also be interesting to give the weight of each machine, which is as follows :—Ingersoll, 800 lbs.; Yoch, 1,100 lbs.; Harrison, 500 lbs.

Of course in making use of the above figures it should be borne in mind that this was a special test and not an ordinary run. It is not reasonable to assume that a man could continue to cut an average of more than 500 sq. ft. per day, but as demonstrating the absolute capacity of the machines when worked by an expert runner the above is a reliable and satisfactory test.

LEGAL.

Reynolds and Another vs. The Attorney-General of Nova Scotia.

(Before the Judicial Committee of the Privy Council.)

This was an appeal from a judgment of the Supreme Court of Nova Scotia sitting *in banco*, dated May 12th, 1894, confirming a judgment of the Hon. Mr. Justice Meagher, dated June 1st, 1893, by which judgment it was held that the appellants, William K. Reynolds and Edwin C. Fairbanks, were not entitled to the renewal of a licence to work a certain coal mining area in Cape Breton. That renewal had been granted on August 21st, 1889, by the Provincial Commissioner of Mines ; but Mr. Justice Meagher declared that it was wholly unauthorized and void, and that Hugh St. Quentin Cayley was entitled to have a lease of the said mining area granted to him by the Commissioner.

Mr. R. B. Finlay, Q.C., M.P., and Mr. George Elliott, appeared for the appellants—Reynolds and Fairbanks ; Mr. Herbert H. Cozens, Q.C., M.P., and Mr. R. M. Bray and Mr. R. L. Borden, Q.C. (of the Nova Scotian bar), appeared for the respondent—the Attorney-General of Nova Scotia.

The facts of the case may be briefly stated as follows :—On December 3rd, 1866, a lease was granted by the Commissioner of Mines of the coal area situate at Little Bras d'Or in Cape Breton county, which is now in dispute, to one Patrick Collins for twenty years from August 25th, 1866. On March 17th, 1874, the said Collins assigned the lease to John Beverley Robinson, who on November 2nd following, in his turn assigned the lease to Andrew Thornton Todd, who on April 18th, 1882, assigned it to the Toronto Coal Mining Company of Cape Breton, Ltd. By the terms of the lease the lessees were entitled, upon giving notice in writing to the commissioner six months prior to the expiration of the lease, to a renewal for twenty years upon the same conditions as were in the original lease, and to like renewals upon the same conditions for a period not to exceed sixty years. The company omitted to give the six months' notice, and on August 23rd, 1887, the appellants obtained a licence to work the said coal area. On August 21st, 1889, the appellants obtained a renewal for a year, and in August, 1890, they were granted a lease of about 670 acres by the commissioner. On April 14th, 1890, Hugh St. Quentin applied for a lease of part of this area, and renewed his application on August 22nd, but the commissioner decided that the ground was covered by the appellants' application. On February 15th, 1892, an information was brought to the Supreme Court of the Province by the Attorney-General on the relation of Hugh St. Quentin Cayley and John d'Arcy Cayley, Frank Cayley, John Strachen Cartwright, executors and trustees of the will of the Hon. W. Cayley, deceased, and Andrew Thornton Todd and the Toronto Coal Company of Cape Breton, Ltd., plaintiffs, against William K. Reynolds and E. C. Fairbanks to obtain a declaration in substance that the relators or some of them were entitled as against the appellants (the defendants in the action) to a lease of certain mining rights, and that the decision of the Commissioner of Mines in favor of the appellants was without jurisdiction and wrong. The action was tried before Mr. Justice Meagher without a jury, and on June 1st, 1893, he delivered judgment, declaring that the extension of the appellants' license for a year from Augusi 21st, 1889, was null and void, as the commissioner had no power to grant a renewal, and that the appellants' rights with respect to the area expired on August 23rd, 1889. An appeal was taken to the Supreme Court, which, on May 12th, 1894, affirmed the judgment of Mr. Justice Meagher (Justice Townsend dissenting.)

Mr. Finlay, in asking that the judgments appealed from should be reversed, pointed out that the Crown, after inquiry, in the presence of all parties, as to their respective rights, confirmed the appellants' title to a lease for twenty-one years, granted on their application of August 20th, 1890. He submitted that his clients had a vested right to the lease.

Mr. George Elliott also addressed their Lordships on behalf of the appellants.

After consultation with his colleagues Lord Watson intimated to Mr. Bray that their lordships would not trouble counsel for the respondents to address them, but would deliver their judgment at a future date.

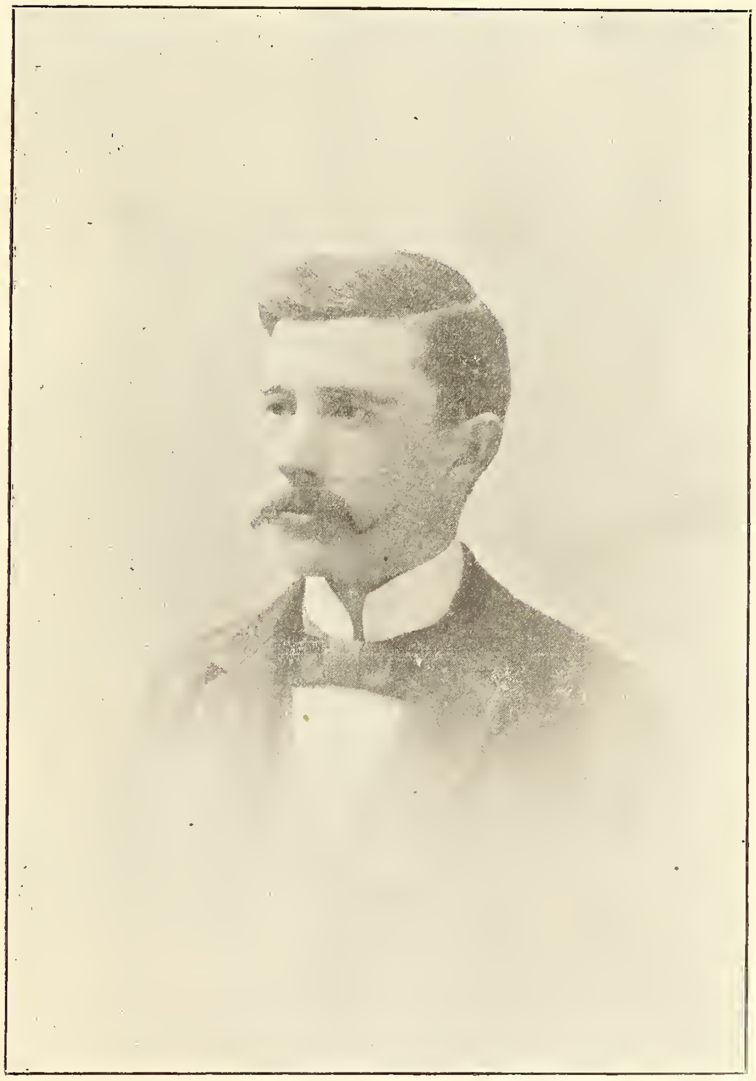
METALLURGICAL NOTES

M. Moissan, the French chemist whose name is associated with the isolation of fluorine, has recently been experimenting on the rarer metals. Moissan has succeeded in preparing pure molybdenum and has investigated some of its properties. Molybdenum has a specific gravity 9, and has properties very similar to those of iron ; it is soft, malleable and may be forged at a red heat ; like iron, it forms a carbide, which may be tempered like steel. Curiously, too, cast molybdenum contains several per cent. of carbon, and is hard and brittle, like cast iron ; it may be softened by puddling it with its oxide, similarly to cast iron. Moissan suggests that it may find a use in the manufacture of Bessemer steel, and would have the advantage over manganese or aluminium that the oxide, being volatile, would go off with the gases instead of being retained in the converter like these metals.

Estimation of Chromium in Chrome Ore. By Edmund Clark (Journal American Chemical Society).—0.5 gram of the finely divided sample is weighed into a 50 c.c. platinum crucible, covered with 25 grams of pottassium hydrogen sulphate and fused over a Bunsen burner protected from draughts ; the heat being gradually increased to sputtering, and finally kept at a moderately red heat for 40 minutes. The contents are poured into a platinum dish, and, when cold, boiled with 35 c. c. of hydrochloric acid and 25 c. c. of water The liquid is then introduced into a beaker into which has been placed the crucible and its cover, to dissolve the remainder of the sulphates. After settling, the clear liquid is decanted and the residue treated with another 15 c. c. of acid ; finally, the liquid is filtered, ammonia added in slight excess and the mixture heated until the odor of ammonia is scarcely perceptible The precipitate freed from lime and magnesia, is re-dissolved in hydrochloric acid, and re-precipitated with ammonia, is dissolved in 50 c.c. of nitric acid (sp. gr. 1.42) heated over a Bunsen flame, and from time to time small quantities of potassium chlorate are added, the gradual oxidation being accompanied by a change from the green color to a clear orange red ; a little more chlorate is added to insure complete oxidation. The iron and allumina are now separated from the chromic acid by means of ammonia, but to render this complete, the precipitate must be re-dissolved in nitric acid and re-precipitated with ammonia ; the united ammoniacal filtrates contain all the chromic acid, from which it may easily be precipitated as chromic hydroxide, by adding hydrochloric and sulphurous acid and then ammonia. Or the liquid may be acidified with acetic acid, precipitated by lead acetate and the chromium weighed as lead chromate. The process admits of the accurate estimation of the iron and other impurities in the ore.

M. Moissan has recently prepared a nitride of titanium, having the composition $Ti_2 N_2$. This compound was prepared by the action of an electric current of from 300 to 350 ampères and 70 volts on titanic anhydride placed in a platinum crucible. With a current of 100 ampères and 50 volts a lower oxide is formed, but by increasing the current the nitride is produced. Titanium nitride, thus prepared, is of a bronze yellow color, has a specific gravity 5.18, and will scratch rubies and cut diamonds. This compound may possibly find a use by replacing diamond in the bits of boring drills.

M. Moissan has also produced a boron steel containing 0.58% boron, 0.17% car-



Mr. A. Dick, Joggins Mines,
General Manager Canada Coals and Railway Company, Ltd.

bon, and 0.30% manganese. The steel is made by first fusing together boron in an amorphous state with reduced iron, when a boride of iron containing 10% boron is formed, and this is added to soft steel in a fused state. Boron steel can be rolled, is readily worked at a dull red heat, but crumbles under the hammer if too strongly heated.

Mechanical tests show that as regards the increase in the breaking strain by tempering, boron steel behaves like a decidedly harder carbon steel, although the diminution in the elongation is decidedly more marked in the latter. It is very remarkable, that tempering has no appreciable effect on boron steel, hence the influence of boron is quite distinct from that of carbon.

Richard Oehmichen has shown by a series of experiments that the direct cupellation of alloys containing zinc, tin, silver and gold, that the results obtained are considerably below the truth.

Mr. J. E. Stead read a paper on the effect of arsenic upon steel, at a meeting of the Iron and Steel Institute, which is of the utmost importance to steel manufacturers. Mr. Stead has conducted a very elaborate series of experiments on steel containing small percentages of arsenic, and he finds that 0.10% and 0.15% of arsenic in steel for structural purposes, does not materially affect its mechanical properties. The tenacity is but slightly increased, while the elongation and the reduction in area of the fractured test pieces is practically the same as a similar steel containing no arsenic. With 0.20% of arsenic, the bending property of the steel is slightly impaired. With 1.0% of arsenic the tenacity is increased and the elongation slightly reduced. The bending properties are, however, fairly good. When steel is required for welding purposes arsenic is very injurious.

Prior to this paper arsenic has been considered equally injurious to phosphorous, to which element it is closely allied, and many steel manufacturers have heen satisfied with steel analysis in which the arsenic and phosphorous are bracketed together, thereby saving the long and tedious method of separating them.

In the *Mining and Engineering Journal*, Mr. E. Andreoli gives an account of a solvent for gold, which he has found in some old papers, and with which we think the majority of people are not familiar :—

"If a few drops of liquor ammonia be added to 20 or 30 grains of iodine, and the compound be slightly heated and stirred over the flame of a spirit lamp, the result is an ammonical solution of iodine, having iodine largely in excess. The fluid thus obtained is an instantaneous solvent for gold leaf, and when saturated with the latter metal it yields upon spontaneous evaporation four-sided prismatic crystals of ammonio-periodide of gold.

"These crystals have very much the colour of iodide itself. The application of a gentle heat disengages one element of iodine and leaves ammonio-iodide of gold as a white crystal.

"A higher degree of heat volatalizes all the iodine and ammonia and metallic gold remains. If a few drops of the solution be crystallized rather quickly on a watch glass, aborescent metallic gold may be obtained under the application of heat.

"The common method of forming the ammonio-iodide is by placing an iodide of the metal in liquor ammonia, or in ammonical gas.

"The method which I adopt is to place the pure metal in direct contact with iodine when dissolved in ammonia. Some caution is required in forming the solution, but with ordinary care, to secure a large excess of iodine which dissolves the teriodide of nitrogen if formed, the explosion of this terrible compound may be avoided.

"Gold leaf placed in the iodine solution instantly turns black (or purple if the solution is diluted), and immediately dissolves like sugar in water."

"The solution of iodine in ammonia may also be successfully used in separating the pure metal from gold ore, obtained in the diggings where the percentage is small. In a commercial point of view, this solution may be in some cases even more available than mercury, and the iodine could be easily collected and used for further experiments."

The above is very interesting from a scientific point of view, but whether it can be used for the commercial extraction of gold from its ores is a matter of considerable question. We notice also that the writer has fallen into the popular error that the black explosive substance formed by the action of ammonia on iodine is a teriodide of nitrogen, the reaction which really takes place may be expressed by the equation :

$$2N H_3 + 2I_2 = 2N H I_2^n = 2H_2.$$

This represents the usual formula, but its composition is liable to vary with differmethods of preparing it.

Mr. A. H. Harris, of Birmingham, England, has patented a method of electroplating with aluminium. He prepares two solutions, one a solution of aluminium nitrate, to which ammonia is added so long as a precipitate is formed; a saturated solution of bi-sulphite of sodium from 30 to 40 times the bulk of the first solution. The two solutions are mixed together, boiled for an hour, allowed to cool and settle, the clear liquid is decanted off and ammonia added to the residue until alkaline. This solution is used in an electro-plating bath, preferably with double aluminium anodes.

Finely divided aluminium is finding considerable favor amongst chemists as a reducing agent. It will reduce carbonic oxide and carbonic anhydride to carbon. If heated with the carbonates of the alkalies it will reduce them to the metallic state. The yield of lithium and potassium is good and as the carbonic oxide compound is not formed in the latter case, the process promises to become of commercial value. With sodium carbonate an atmosphere of hydrogen is necessary.

A carbide of aluminium is formed when the finely divided metal is heated with lamp black, which yields acetylene in abundance when treated with dilute hydrochloric acid. If the finely divided metal is heated with red lead, reaction takes place with explosive violence, and the charge is ejected from the crucible.

A new mineral has been discovered in the Laurium mines in Greece, and is called lossenite, in memory of the late C. A. Lossen. It occurs in minute brownish red crystals belonging to the rhombio system, and has the formula :—

$$2\ Pb.\ So_4,\ 6\ As_2\ O_8\ (Fe\ O\ H)_3,\ 27\ H_2\ O.$$

We have received from Messrs. A. B. Fleming & Co., of Edinburgh, Scotland, a book giving a very interesting account of agalite, for which substance they are sole European consignees.

Agalite is a natural silicate of magnesia and is very free from sand, grit and iron, it is a fibrous mineral and is used as a "loading" for papers requiring a high gloss. It has the advantage over china clay, gypsum and barytes as a loading, inasmuch that not only is a very much larger per cent. of the agalite retained in the paper than is the case with the above named minerals, but a larger amount of the actual pulp is saved, the fibrous serrated edges of the agalite seizing hold of the pulp fibres and retaining them in the paper. Comparative experiments with agalite and china clay, made by Professor Ivison Macadam, showed that while 63% of china clay passed into the "effluent," only from 5% to 7% of agalite was so wasted.

The mineral is composed of silica, 62·1 ; magnesia, 33·1 ; water, 4·3 ; oxide of iron, 0·1; alumina, 0·3; undetermined, 0·1.

A Pass-Bye in a Shaft.

At a meeting of the North Wales branch of the National Association of Colliery Managers, Mr. W. H. Wilson, M. E., read a paper on "A Pass-bye in a Winding Shaft." The paper gave a detailed description of a pass-bye arrangement at present in course of construction at the Llay Hall Colliery, Cefn-y-bed, near Wrexham, the object of the arrangement being to run two cages in a shaft where formerly it was only possible to run one, the same result being attained at a cheap cost combined with as much safety as in a shaft of large diameter. The system of pass-bye is applicable only to a shaft with wooden guides, and in this particular instance is a shaft of 9 ft. diameter and 270 yards in depth. The pass-bye from its commencement to its finish covers a vertical length of 100 yards and is subdivided into the following sections, viz., 8 yards, 35 yards, 14 yards, 35 yards, and 8 yards; the 2nd and 6th measurements are inclined inwards and outwards from and to the centre 14 yards, the other measurements being vertical. The cages are 5 ft. by 2 ft. 7½ in. over all, and are double decked single tub cages (the same can be made to suit either single, double, or treble decked), with one tub on each deck, and taking a tub of the following dimensions:—20 in. gauge, 2 ft. 3 in. wide, 2 ft. deep, and 4 ft. 2 in. long, being 4 ft. 6 in. over the buffers. Each cage has eight cast-iron shoes fixed on—that is four shoes on each square of the cage ; those on the ends of the cage are half-shoes only, well bracketed, bolted on to the angle iron of the cage with bolts with counter-sunk heads, and have lock-nuts with cotters through same ; the four shoes on the sides of the cages are the ordinary shoes which run on wooden guides in any shaft. The cages are steel throughout, and are of the most improved and latest design, and are in every way made suitable to work on this system of guiding.

Commencing from the top of the shaft in a downward direction the bearers are placed in the centre of the shaft—that is, equidistant from each side of the shaft, the same being 4 ft. 5½ in. hetween them, and are 9 in. by 5 in. pitch pine. They have wood brackets 1 ft. 6 in. by 9 in. by 4½ in., bolted on them, and with their edges in a longitudinal direction rounded 2 in. from the square of their length and thickness respectively at each end ; on these are bolted the guides with slightly rounded edges, and are bolted to the brackets and bearers with T-headed ¾ in. diameter bolts. The guides are 5 in. by 4 in. hard pitch pine, and project the 5 in. way into the shaft. There are two guides to each cage immediately opposite each other the same being 7 in. centre to centre, being 3½ in each way from the centre of the shaft, and thus allowing 3 in. clear space between each, so that each cage has its own guides and only travels on those. If you stand facing the pit head on its front the right and left-hand guides in each case run right through, from top to bottom of the shaft—that is, the two guides diagonally opposite to each other, the other two guides diagonally opposite the whole (being four in number)—to a point 8 yards below the commencement of the pass-bye, and there finish, the terminal of each being a cast-iron block of the same section as the guides and bolted on to the bearers 5 in. long and 4 in. wide, and tapered each way to an apex ; these same two guides commence again in the same centre line of each other 8 yards from the finish of the pass-bye, and commence with a cast-iron block and run from thence to the bottom of the shaft. Mr. Wilson states that it would not be necessary in every case to make the shaft oval at the pass-bye ; this would depend solely on the size of the tub required to be used.

Joints for Steel Wire Ropes—Usually the weak portions or broken ends of wire rope are spliced to extend the life of the rope, but in each splicing 6 or 8 feet of rope are wasted. Mr. W. Seaham has devised a strong joint which will connect the two ends by a single piece of slight dimensions and one which can be made by unskilled men with ordinary tools. A steel block of ovoid form is drilled with two conical holes slightly oblique to the direction of the rope and the conicity opposite to each other. After the rope ends are introduced into the holes a tapered drift or pin is driven into the heart of each rope end which thus splays out the wires. The space is further filled by driving in small tapered nails until no more will enter. For haulage ropes the block may be cylindrical to form also a stop for hitching behind the fork of cars to be drawn along. Any number of these may be added without impairing the utility of the rope and yet materially prolonging the life of the rope.

Mining Bureau for British Columbia—Hon. Col. Baker, in his capacity of minister of mines, has caused to be sent out to the various mining recorders throughout the province, circulars requesting them to gather every possible information as to mines and mining operations in their districts. This information will be forwarded through the gold commissioners of the districts to Victoria, with samples of ores from the mines, also samples of the rock from the hanging and foot walls. This is the first move towards establishing a bureau of mining for the province. A portion of the provincial museum will for the present be set apart for the specimens of ore from the different mines, and the fullest information obtainable as to the nature of the ore, the workings of the mine and the geology of the vicinity will be kept on record. Then when any inquiry is made as to any mine, or of the progress or prospects of any district, from the data at hand the fullest information obtainable will be furnished. This will be of enormous benefit, especially to would-be investors, and will aid greatly in the development of the British Columbia mining industry. The records will be kept up to date and made as accurate as possible.

Shot Firing.—In a paper before the Midland Institute of Mining Engineers Mr. George B. Walker described an invention of Dr. Rob's, the inventor of robrorite, by which chlorine gas, generated in a suitable vessel, was allowed to pass through a tube inserted in the stemming of the shot-hole to a detonator charged with metallic antimony and fulminate of mercury. The chlorine reaching the detonator, combined with the antimony, produced heat which exploded the fulminate mercury, and the explosion being produced entirely by chemical combination no spark or flame was produced. It was claimed that the method was a cheap one as compared with electric detonators, but whether this was so or not, and whether the necessary conditions could be carrred out in practice by ordinary workmen, would have to be tried, but the method was undoubteply an ingenious one.

The Late Mr. John M. Reid,
Manager, Oxford Gold Mining Co.

ST. LAWRENCE COAL DELIVERIES.

The following is a comparative statement of the quantities of bituminous coal delivered at the ports of Montreal, Sorel, Three Rivers and Quebec, for the first three months of navigation, compared with the same period last year. The figures show a decrease of 13,868 tons from Cape Breton, an increase of 29,362 tons from Pictou County, and a marked increase in the imports of foreign coal, amounting to 21,471 tons. Of the Cape Breton imports about 220,000 tons came from the collieries of the Dominion Coal Co., while the whole of that credited to Pictou, was from the Drummond Colliery of the Intercolonial Coal Co. The Royal Electric Co., Montreal, we believe, are the largest importers of foreign coal this season, about 30,000 tons of so called slack having been brought in for them :—

From.	Port of Montreal.				Port of Montreal.				Sorel.		Three Rivers.		Quebec.		Grand Total.	Grand Total.
	1894.				1895.				3 Months.		3 Months.		—		May, June, July.	May, June, July.
	May	June	July	Total	May	June	July	Total	1894.	1895.	1894.	1895.	1894.	1895.	1894.	1895.
Cape Breton........	47,736	83,329	114,216	245,281	35,254	87,503	95,806	218,563	7,794	11,459	5,191	7,618	25,706	32,454	283,972	270,104
Pictou County.......	7,815	7,951	7,281	23,047	5,950	10,539	15,920	32,409	..	....	..	..	...	....	23,047	32,409
English, Welsh, Scotch & Amer'n Bituminous	11,354	6,363	5,651	23,368	13,216	15,421	22,187	50,824	1,932	....	..	..	11,925	7,872	37,225	58,696
	66,905	97,643	127,148	291,696	54,420	113.463	133,913	301,796	9,726	11,459	5,191	7,618	37,631	40,326	344,244	361,209

Improvements in Water Spraying Apparatus for Damping Dust in Mines

Mr. Wm. Saint, one of H. M. Inspectors of Mines, at a recent meeting of the Manchester Geological Society, conducted a number of experiments descriptive of water-spraying in mines, in explanation of which he said that the spraying system of watering mines was adopted at about forty collieries in South Wales alone, and it appeared to him that the reason why it had not been more extensively applied was mainly due to the difficulty in obtaining a spraying apparatus which would work satisfactorily without close attention, and at the same time give a fine spray free from drops of water. The coarse spray and drops fell to the floor immediately on leaving the nozzle and saturated and softened the floors of most mines, thereby causing them to heave and greatly increasing the expenditure necessary to maintain the roads in good working order. Apparently, therefore, if they could find a suitable sprayer that would give a uniformly fine spray capable of being distributed by even a moderate current of air, they might reasonably hope to arrive at a satisfactory solution of the problem of watering mine roads in the most convenient and economical manner. With this object in view, he had applied to Mr. Hugh Bramwell, the agent of the Great Western Collieries, near Pontypridd, for samples of the sprayers used in South Wales mines, and he very kindly, not only sent several spray fittings, which he, (Mr. Saint) was about to show, but also some notes describing the arrangement of water pipes, etc., in those extensive collieries, which would be read to them later on. Other forms of sprayers he proposed showing, consisted of Bray's gas burners, which he had seen used in one or two Lancashire mines, and a new form of sprayer which they saw running would also be described. The water was obtained from the town's main at a pressure of about 65 lbs. per square inch. They would begin with gas burners.

1. Bray's gas burner 000. This gave a fairly good spray and also a considerable quantity of solid water.

2. Bray's gas burner 00. This showed a better spray, but with solid water in about equal volume.

3. Bray's gas burner 0. This gave a more copious supply of spray with a larger proportion of solid water.

4 and 5. Bray's gas burners 1 and 2. Gave similar results to No. 3.

The next experiments were with fittings from South Wales.

6. Half-inch iron T piece, with an adjustable brass plug fitting into a countersunk hole in the iron pipe. This is liable to corrode and choke up, and unless there is a separate cock in addition to the plug it cannot be kept in order. It gave a good spray, accompanied by a heavy leakage of water at the back end of the plug.

7. Brass sprayer with single needle hole and brass plug. When provided with a separate cock it is considered a fairly satisfactory sprayer, but it also discharges a considerable amount of solid water.

8. Brass rose, with removable face for cleaning, and quarter-inch gland cock with numerous holes. For thorough watering, say when shot firing, this has been found most useful, and it is used frequently for the purpose at the end of a hose pipe which the waterman attaches to the mains as required. The holes vary from one-sixtieth to the one-hundredth of an inch, and they give a large supply of very coarse spray.

9. Brass sprayer with three needle holes and one adjustable brass plug. This is another form of No. 7. It does not become choked up so easily, but has no other particular advantage. It gave three jets and appeared to be difficult of adjustment to form spray.

10. Brass sprayer with screw plug and removable sprayer or nipple, with five holes. This has been designed by Mr. Bramwell to take the place of both a sprayer and stop cock. The advantages claimed for it are ;—(*a*) A separate stopcock is not required. (*b*) The spray nipples can be easily removed for cleaning or renewal at any time. (*c*) It can only be put in or out of action by a special key. It is said to act satisfactory in the mine, but possibly owing to the limited pressure at our service to-day it gives five jets of water and very little spray.

11. A sprayer of novel design. Inside the head of the fitting was a chamber, in the wall of which a hole was drilled in such a manner that the water entering it under pressure whirled and issued through the discharge hole in a spiral form, and immediately broke up into a mass of fine spray, free from drops of water. As they had seen, it had been running during the course of the preceding experiments, and give a superabundance of spray, equal to about 9 gallons per hour, and appeared to work satisfactorily. But if the hole in the loose cup became choked with dirt or the cup was removed a powerful jet was the result.

The experiments had been conducted under somewhat favorable conditions as regards the purity of the water. With impure water, such as was generally used for watering purposes at collieries, worse results might be expected. The sprayer discharge holes were necessarily so fine that a particle of dirt was sufficient to stop the spray, and the water then oozed out and fell to the floor beneath the nozzle. In order to meet this difficulty he had designed a small filter which might be made of any porous material. The one before them attached to the new sprayer contained a sponge and was of a compact form and could he fitted to any type of sprayer. It effectually separated any mechanical impurities contained in the water, whether due to dirt or corrosion of the pipes, and insured the constant running of the sprayers for a long time. He had tested the filter with sludge and grit in the water and found the sprayer was not affected in the least.

The object of the experiments had been to demonstrate the defects in the fittings at present being used in mines for spraying purposes, and also to show the new method of producing a superior spray, by which they might reasonably hope to overcome the objections which existed on the part of many to the introduction of the spray system of watering dry and dusty mines.

The members then re-assembled in the Mining School, and Mr. Saint read the following description of the arrangement of the water pipes, &c., at the Great Western Collieries, by Mr. Hugh Bramwell.

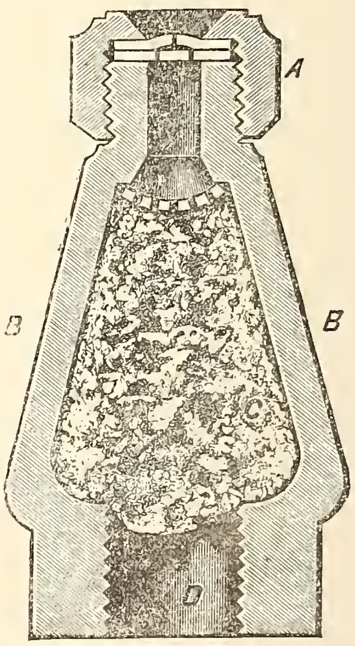


FIG. 1

PIPE SYSTEM.—The watering pipes were specially put in for dust laying and supplying horses, in 1885.

They consist of 1¼ inch wrought-iron main pipes, tested to 2,000 lbs. per square inch, with ½ inch upright pipes for the sprays every 40 yards. The distance of 40 yards is, under ordinary circumstances, unnecessarily short, but as the sprays are liable to get choked it is advisable to have plenty. Part of the pipes in the shaft have been replaced by 2 inch ones, and it is intended to renew them with 3 inch pipes.

The pipes are connected at the surface with the main from colliery reservoir. The head of water in the various seams is as follows :—

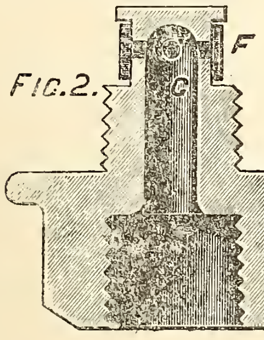
4 ft. seam........	1,055 feet head,	or 458 lbs.	per sq. in.
6 "	1,225 "	" 532 "	"
5 "	1,475 "	" 640 "	"

At present there are 12,000 yards, or about 7 miles, of pipes in the shaft and spread out along the main roads in the seams above mentioned. There is provision for about 250 sprays, but we are watering principally at present by means of a "rose" on a "hose" pipe, which can be attached at intervals to the mains. There are also about thirty 1¼ inch cocks for filling cisterns for horses, and as fire hydrants at the underground engine houses.

Mr. Saint added that the improved spraying apparatus would, in its complete form consist of a back-pressure valve, filter and sprayer, and where required to reduce excessive pressures a regulator also, and beyond setting it would require no further adjustment. With this combination and a reliable sprayer it would, he thought, be an easy matter to arrange for the watering to be done automatically and intermittently, and he had patented such combination and arrangements by which the sprays might be automatically run or stopped for any required length of time, either by mechanical or electrical means, or the water may be turned on and off by hand at the main or branch valves, without the necessity of employing a waterman to operate each individual nozzle tap as at present. He would, where practicable, prefer the watering to be constant; but unless they could obtain a good sprayer, which would discharge a small volume of water in a finely divided state into the air current, it seemed to him that the supply would necessarily have to be regulated and applied at fixed intervals, as he thought there might be objections on the part of the workmen to the watering being done whilst they were travelling the main roads.

Mr. Mawson said with a spray of that sort in an ordinary mine an hour's working would be quite sufficient, and he asked whether, instead of having so many sprays, it would not be possible to have them taken along the workings, taking the sprayer off and connecting it to another stand-pipe, and then to another, and so on. At present they had to have a man constantly watching the sprays to see that they worked properly, and this new system, especially with filters, seemed to overcome that.

FIG. 2.



Mr. Saint replied that, in his opinion, to manipulate the nozzles as suggested would be a needless expense. He thought the sprayers should be stationary, and the water having been turned on, the air current should be utilized to distribute the spray. The fine sprayer was quite new, and had not been tried in any mine up to the present, but he should like some gentleman to allow a few of them to be put to work in a dry and dusty mine, so that they might be thoroughly tested. What they wanted to do was to damp the road and leave it for a time, and give it another damping before it got dry, and they might regulate the mechanism accordingly, so that it would work automatically, and not be under the control of a workman in the mine. The system he proposed would be cheaper to install than that at present in use, which required the use of pipes capable of withstanding high pressures. Besides it would be reliable, and comparatively inexpensive to operate.

Mr. Crankshaw proposed a vote of thanks to Mr. Saint, and said it seemed to him that Mr. Saint had solved the problem of the effective damping of dusty mines. The system, which had been explained to him, was automatic and simple, and would do its work without causing any damage to the floor, roof, or sides of the mine. Mr. Saint was to be congratulated on developing a system which was infinitely superior to anything in use at the present time.

Mr. Hall, who seconded the motion, said he always thought when he heard these descriptions that the danger was that it became too intricate. He had expressed the opinion that in the long run the best method would be to have a long hose, and to let a man apply the water with it. Since then he had had an opportunity of seeing a hose down the pit, and found it answered most excellently. They walked at the rate of about two miles an hour, and watered everything in front of them. When they had sprays running in different parts of the pit continually the men got drenched in passing through the mist, and they got in the habit of turning off the taps to avoid it. But when the man with the hose saw the men coming he could desist. Since trying those experiments under ground, he was more convinced that it would be the best method to have a system such as Mr. Saint had shown them, but to use it with manual labor.

The Superficial Alteration of Ore Deposits.*

By R. A. F. Penrose, Jr.

The modern idea of ore deposits teaches that formations of this kind represent a process of concentration of mineral matter, either by chemical or physical means; in other words, that they are unusual localizations of certain minerals which are often found disseminated in smaller quantities in many common rocks, and that they differ from the same minerals situated in other conditions only in their degree of concentration. It is not, however, the purpose of the present paper to enter into the discussion of this subject, and the following remarks are confined to what happens in the superficial parts of ore deposits, and, to a less extent, of allied formations, after the materials forming them have been brought into their present, or approximately their present positions.

Ore deposits are generally more or less changed in their upper parts by atmospheric influences, so that very rarely do the same mineralogical and physical features that are found in these parts continue to very great depths. This superficial alteration is a subject analogous to the secular decay of rocks, but the latter involves only a limited number of common rock-forming minerals, while the secular decay of ore deposits involves a great variety of minerals, not only the oxides, carbonates and silicates, common in most rocks, but also sulphides, tellurides, selenides, antimonides, chlorides, bromides, iodides, fluorides, sulphates, phosphates, tungstates, molybdates, and numerous other classes of minerals, many of which, under surface influences, give rise to intricate chemical changes. The altered surface outcrops of ore deposits are known among the Cornish miners of England as gossan, a name which has also been adopted into American mining nomenclature, though other special names are given in special classes of deposits; in France it is known as "chapeau de fer;" in Germany, as "eisener hut;" among the Spanish Americans as "pacos" or "Colorados."

The superficial alteration of ore deposits, as of any rock, results from a combination of mechanical and chemical disintegration, brought about by the combined action of the atmosphere, surface waters, changes in temperature, and the various organic and inorganic materials contained in the air and water. In nature we never deal with perfectly pure water, but different waters contain different ingredients derived from the air and from the different materials with which they come in contact. Among the most important of these ingredients are oxygen, numerous organic acids like carbonic, nitric, oxalic, malic, citric, formic, propionic, butyric, acetic acids, etc., certain inorganic acids, such as sulphuric, hydrochloric, hydrobromic, etc. Some of the acids mentioned occasionally occur in the free state, but most of them are generally combined with some of the bases present, such as the alkalies, lime, magnesia, iron, alumina, etc.

Surface waters thus charged with various chemical ingredients percolate down into ore deposits, and there meet various materials which are even less stable under their influence than most of the common rocks. From a chemical standpoint, the first effect of this superficial influence is usually the oxidation or hydration, or both, of certain ingredients, followed generally by the formation of other chemical combinations, and by the leaching of certain materials. The action is sometimes one of reduction, which, however, often follows a previous oxidation. The process of alteration also frequently causes a leaching of certain ingredients of the ore deposit, either with or without previous oxidation, as in the removal of iron pyrites, calcite, etc. It also sometimes renders a hitherto worthless material valuable by the introduction of a valuable constituent, as in the replacement of carbonate of lime by phosphate of lime. It also causes the concentration, by capillary action in soils, of certain deposits like nitre, etc. The materials in surface waters affect different bases differently, and, therefore, there is a great difference in the classes of salts formed by the same surface waters on the ores of different metals. In the same deposit there may be formed an oxide of one metal, a carbonate of another, a chloride of another, etc. As a result of these various changes, certain materials are sometimes leached from the upper parts of ore deposits, which have become porous by alteration, and carried down to the less previous unaltered parts. Here they are precipitated by meeting other solutions or in other ways, and hence the richest bodies of ore in a deposit often occur between the overlying altered part and the underlying unaltered part. This is not always the case, but it is true of some copper, silver, iron and other deposits.

From a physical standpoint, the effect of superficial alteration is generally to make the deposit more open and porous, to cause it to shrink, and, in some cases, to convert it to a loose material of the consistency of sand and clay. In some cases, however, especially where considerable hydration goes on, an expansion may be caused. Surface decomposition has in many places not only affected the ore deposit itself, but also the country rock in the immediate vicinity, and has converted it into a loose material of a sandy or clayey conistency.

When surface waters percolate into the rock, their influence is more active near the surface, because they carry large quantities of oxygen in solution, and because the oxygen of the air itself has some influence. As they sink deeper the effect of the oxygen of the air becomes less active, and the oxygen dissolved in the water is consumed in oxidising various materials which it meets on the way, until finally most of the oxygen is lost, and active oxidation ceases. Theoretically, this oxidizing action may extend down as far as, and sometimes below, the level of the drainage of the surrounding country, which is called also the zone of permanent saturation. Above that level there is a constant circulation of water from the surface downwards, thus affording means of active oxidation; but when the water reaches that level, not only has most of the oxygen contained in solution generally been used up, but also the circulation of the water is much more sluggish, so that oxidation is less active.

The process of hydration, when the materials affected do not require oxidation before they can become hydrated, may, as in the kaolinization of feldspar, extend down indefinitely below the limit of oxidation; but when oxidation is necessary before hydration is possible, the latter process, of course, can extend no deeper than oxidation. The various materials other than oxygen in surface waters are also more active above the drainage level of the country than below it. Though theoretically, therefore, alteration may extend down to, and in some cases much below the level of permanent saturation, yet in many, if not most, cases it has not yet reached that level. The actual depth to which alteration does extend varies with the topographic conditions of the region, the chemical nature and the porosity of the deposits affected, the character of the climate, and other minor conditions.

As a result of all these influences, surface alteration is found to extend in different ore deposits to depths varying from only a few inches, or in fact only a fraction of an inch, to several hundred and even a thousand or more feet. In glaciated regions the products of decay have often been swept away by glacial action, and the time which has elapsed since then has not been sufficient for alteration to have extended to any great depths; while in regions of moist climates, the erosion sometimes, though not always, keeps pace with the alteration, so that the depth of the change is shallow. In those regions, however, which have not been recently glaciated, and which have dry or only moderately moist climates, but which, on account of their topography, are not subjected to very active erosion, the products of alteration collect, and the changes are traceable downwards often to great depths.

Most workable iron deposits are the result of a concentration subsequent to their deposition, while very few are due to a direct deposition during the formation of the enclosing rocks, though some may be due to a process of differentiation in the cooling of eruptive magmas. The original presence of the iron in sedimentary rocks was doubtless due to a direct precipitation during the formation of the enclosing rock, but it was then in a finely disseminated condition, and it was only by being subsequently taken into solution again by percolating waters and concentrated that it was converted into bodies of greater or less purity. Generally, though possibly not always, this process is superficial, and though it may extend to a depth of several hundred, or even a thousand feet or more, it can be traced directly to surface influences, and its effects are seen to decrease gradually with depth. Most, if not all, the iron deposits of the Lake Superior region, the Appalachian Mountains, and other places are probably due to such causes. Manganese deposits are affected by superficial influences in somewhat the same way as iron deposits.

In many copper deposits superficial alteration has produced very remarkable chemical and economic results, and this is especially well seen where copper sulphide deposits have been affected. Such deposits are usually associated with much larger quantities of iron pyrites, and when this mixture is oxidised the result is a brown or black ferruginous mass with brilliantly colored oxidized copper minerals, such as cuprite, malachite, azurite, chrysocolla, &c., while below, at depths varying from a few feet to several hundred feet, the deposits usually pass into a mixture of copper pyrites and iron pyrites, the latter usually being far in excess.

In the case of lead deposits, the mineral galena, which is the commonest ore, is frequently more or less altered on its surface outcrops and converted to the sulphate (anglesite) and the carbonate (cerrusite). The first product of oxidation is anglesite; but this readily unites with carbonic acid or soluble carbonates in surface waters, forming carbonate of lead, or cerussite. In rarer cases, other lead materials, such as phosphates are also formed.

In the case of zinc, the most common ore is the sulphide known as blende. This material, like galena, is generally oxidized on the surface, and forms by chemical changes the carbonate (smithsonite), the basic carbonate (hydrozincite), and the basic silicate (calamine), in a manner similar to that described in copper and lead ores.

*Abstract from an article in the *American Journal of Geology*.

Deposits of argentiferous galena and other silver minerals are, when oxidized, altered with the formation of native silver, chloride of silver (cerargyrite), bromide of silver (bromyrite), iodide of silver (iodyrite), and various other minerals.

The typical unaltered condition of gold in nature is in association with iron pyrites in quartz, and the effect of surface oxidation on such a deposit is first to convert the iron pyrites into hydrated oxidized iron minerals which permeate the quartz and turn it into a rusty brown mass. The next stage is the gradual leaching out of the iron minerals by the action of surface waters, while the gold, which was originally in the iron pyrites, mostly remains, though it may have been partly dissolved in one or more of several ways. Sometimes, especially in the Rocky Mountain region, gold occurs in the form of telluride instead of in iron sulphide, and in such cases superficial oxidation causes the telluride to be oxidized and the gold to be set free from its combined state. When such deposits as those described are eroded, the particles of gold separate from the quartz and are concentrated in the streams as placer gold.

In tin deposits, the typical mode of occurrence of the metal is in veins, dykes, or country rocks in the form of the oxide known as cassiterite. Cassiterite is not easily affected chemically by surface influences, but for this very reason its concentration is most markedly affected by surface alteration, for in the erosion of tin-bearing deposits the masses of cassiterite are broken up and carried off mechanically by surface waters, to be deposited somewhere else in the form of gravel beds, instead of being dissolved and possibly disseminated.

Superficial alteration like that already described in various deposits occur also in many others, such as antimony, bismuth, mercury, aluminium, nickel, cobalt, chromium, tungsten, molybdenum, and many rarer deposits, but the changes already described show the general features of the subject.

As soluble chlorides, and sometimes other haloid compounds, are common in surface waters, chlorides and the allied salts are not at all uncommon as alteration products, especially in such cases as that of silver, where the chloride, bromide and iodide are comparatively insoluble compounds, and are not leached out. For this reason, such ores of silver are found to a greater or less extent in almost all silver districts in America, Europe and elsewhere. The occurrence of such compounds in very large quantities in certain arid parts of America is probably due to the action of saline compounds, derived from wholly or partly dessicated lake basins, on the pre-existing ore deposits of the region. This transition to haloid compounds is not confined to silver ores, for similar compounds of copper and other metals also occur.

Rock Drills.*

It is observed that Andre, referring to rock drills in his work on "Coal Mining," states concisely the requirements of a good rock drill, as follows:—

1. A machine rock drill should be simple in construction, and strong in every part.
2. It should consist of few parts, and especially of few moving parts.
3. It should be as light in weight as can be made, consistent with first condition.
4. It should occupy but little space.
5. The striking part should be relatively of great weight, and should strike the rock directly.
6. No other part than the piston should be exposed to violent shocks.
7. The piston should be capable of working with a variable length of stroke.
8. The sudden removal of the resistance should not be liable to cause any injury to any part.
9. The rotary motion of the drill should take place automatically.
10. The feed, if automatic, should be regulated by the advance of the piston as the cutting advances.

Having assented to these requirements, the catalogue continues: The power of a rock drill is in direct proportion to its diameter of piston. It is of the greatest importance that a drill of proper size is purchased for the work it is to do. It is impossible to determine by figures that a rock drill of a certain diameter of piston will be best suited for a particular piece of work. This can only be learned by experience.

It is a common thing to see rock drills of too small a size used in work where a larger drill would save money. We have also seen large drills used where small ones should be. It is a common thing for salesmen inexperienced in the rock drill business to advise the purchaser to buy a drill of a smaller size than will be best suited to his work. This is sometimes done by salesmen and manufacturers of experience, but whose interest in effecting the sale binds them to the real interests of their customer. It is easier to sell a small drill because the price is lower, and many men who have been tempted by the low priee have purchased smaller drills than they should have, and some are to-day using them satisfactorily, but are really losing money, as a large drill might do more work in the same time and at the same expense in labour and fuel. It is like putting a boy to do a man's work. It costs as much to feed the boy, but the man accomplishes more in the same time.

There is distinct tendency of late years among the most successful and experienced quarrymen, miners, and contractors toward the use of heavier and more powerful machines than were used for the same work only a few years ago. A light drill is, of course, the choice of the drill runner, because he thinks it will be easier for him to move around, and many quarrymen insist upon having a light machine, for precisely the same reason. A drill too small for the work it has to do is never a paying investment, and the slight difference in first cost between a small drill and one of proper size should never be allowed to influence the matter, as this small difference will, in many cases, be made up every week in the difference in work done. Again, experience shows that the larger machines are much more durable and economical in repairs, not as apt to break down, and will outlast several of the smaller ones at the same work.

On the other hand, large drills should not be used for shallow holes of small diameter in soft rocks, where the time taken to move the machine is out of proportion to the time it takes to drill the hole. Many are using rock drills, as they think satisfactorily, when a larger or smaller, or a different pattern of machine, would be a surprise as to its greater capacity. Good machines are sometimes condemned when the only trouble is in their being unsuited for that particular work.

There are many kinds of bits in use, each having its specific value when applied to certain kinds of work. Obviously the best bit for use is that which is the simplest in construction consistent with efficiency. It may be stated as a general rule that the single-edge bit should be used everywhere that it is possible to apply it, so great is its simplicity. It cannot be used with percussive drills in hard rock because the blow is so strong that the edge will not stand. Here is where double-edging comes in to advantage, for, having plenty of power behind it, we may distribute that power over two or three edges, and thus gain an advantage.

A straight edge, when used for hole drilling, brings most of the work upon the outside points of the bit. These points turn around through the largest circle, that which limits the diameter of the hole; and, besides, they have to break up the stone at the wall, where it offers the greatest resistence. The taper or curve eases this condition of things by changing the bottom of the hole so that it has no sharp corner.

Sandstone has a singular effect on drill bits. Though sandstones are usually soft the bits cannot be finely pointed, but, on the contrary, should be flattened. A bit with a knife edge when used in sandstone will have its edge sharpened like a razor, the faces of the bit gradually becoming concave. This is natural, because, as the bit embeds itself in the grit of the rock, it is rubbed as though on a grindstone. The stone is not usually hard enough to dull the sharp line of the edge, so that the more this bit is used the sharper it gets. It cannot, however, be used very long, because the point or outside ends of the bit become flattened and dulled, and what is a still greater objection, the ends become tapered. All this arises from the hard work and the great rubbing experienced at the walls of the hole.

The most successful sandstone bit is undoubtedly that with the flat edge. This bit is nothing more than a flattened-out piece of steel, with no more edge to it than there is to the side of your finger. It is sometimes called the stub bit. Exact dimensions of this bit cannot be given that will apply in all cases, but the most popular dimensions are about 1½ inches length of face, and from ⅜ to ⅝ inch in width. The cutting face should be square and rectangular. The bit should be kept thin to insure fast cutting, but, if a cornered hole results, thicken the bit a little. It is usual to simply dress it up by heating it and hammering it to square edges, the chief work having to be done upon the outside ends in order to keep them square and up to gauge.

There is so much metal in the sandstone bit that it is not rapidly worn away by the grit. It is, therefore, a common thing to see one of these bits in use for half a day, drilling a great many holes in different places, without having to be sent to the shop. When starting a hole it pounds upon the rock like a bass drum, and an inexperienced looker-on would naturally suggest a sharper edge.

There is no question about the advantage of the flat bit in sandstone, so far as the blacksmith work is concerned. It will actually put in a hole faster, and it does it because, when drilling sandstone, the process is not a chipping, but a crushing one. Marble, or any other hard crystalline substance, needs a sharp edge to throw a chip, whereas sandstone will crush.

Prior to the use of the percussive drill there were few, if any, drill bits which had much value above that with the single edge. Even in artesian well boring, where the blow is heavy, the single edge bit has held its place against many patented bits. The single-edged bit is generally flattened or grooved at its centre for the purpose of discharging the cuttings. As the centre of any bit performs but little work, it may be readily cut away without reducing the efficiency. Besides the single-edged bit, the +, × and Z bits are the only really important bits in use with percussive drills.

The + bit is the most popular percussive drill bit in use. It seems to be a happy medium in that it accommodates both the drill runner and the blacksmith, though we are quite sure that, were the blacksmith's wishes not consulted, the × bit would replace it almost everywhere. Out of several hundred enquiries recently sent out among mining and quarrying men as to which bit was preferred, the + or the ×, opinions differed largely, but the weight of evidence was in favour of the + bit.

It may be stated as a general rule that the × bit will do good work in any kind of rock where the + bit is used, but the + bit cannot be used to advantage in some rock where the × bit gives satisfaction. Another rule is, that the + bit had better be used wherever the rock will admit, for the simple reason that it is more readily dressed by the blacksmith.

The two bits are very much alike in that they have the same extent of cutting edge, but they differ in that the edges in one case cross at right angles, and in the other at acute angles. As the bit, when at work, turns round after each blow, it is obvious that in the case of the + it may strike four times in the same place while turning the circle, while with the × it can only strike twice in the same place. A + bit, when turned one-quarter of the circle, or 90°, may embed itself in exactly the same groove that had been made by a recent blow, and, if this striking in the same place is frequent, and the rock is soft enough to admit of rapid drilling, the hole will become rifled, that is, it will not be round. Anyone who has much to do with drill holes knows that a rifled hole is a great nuisance. As the × bit has only half as much chance to strike in the same place as the +, it offers only one-half the opportunity to rifle the hole. It is a common thing for percussive drill manufacturers to receive complaints that "the drill will not put in a round hole;" the invariable remedy is to change the bit, and, as a general thing, the × bit is the thing to use.

In the blacksmith shop, the + bit is invariably preferred. In using the dolly the blacksmith finds that by turning it one-quarter it fits the bit, and, owing to the rectangnlar and uniform construction of the bit, he has no difficulty in keeping it at gauge, while with the × he must turn his dolly one-half of the circle, and in doing so the bit must either be turned around, or he must send his helper on the other side of the steel. It is because of this very condition of things as illustrated in the blacksmith shop that the × bit when turning around in the hole is less liable to strike in the same place, and drills a better hole. Persons using the + bit and having difficulty with rifled holes can try the experiment by simply knocking the flanges of the bit together in the blacksmith shop, while the steel is hot and after it has been dressed. If they find that this bit will drill a more satisfactory hole, they had better throw away their + dolly and send for an ×, the blacksmith to the contrary notwithstanding. In trap rock, granite and other uniform rocks the + bit does good work and drills a round hole because the rock is uniformly hard, and the drilling is consequently slow.

The Z bit is designed and used to a moderate extent in soft rocks, or in work where seams and soft places are found in the line of the hole. This bit is sometimes modified by having the middle edge straight across, thus making an Ξ instead of a Z, but there is little preference between the two, and either one is bad enough for the blacksmith to dress.

A matter which frequently receives too little attention from the drill runner is the keeping of the bit in the proper shape. Generally speaking, they should be as thin and sharp as they can be made without breaking or sticking. It is a common thing to run × or + bits till they are battered or worn so blunt as to make cutting out of question; it is then a matter of brute force. Two or more sets of steels should be used, so that a sharp set is always available without waiting for the blacksmith. Always remember to keep the bits dressed for as small a hole as will do the work; there is just four times as much rock in 2 inch holes as there is in 1 inch; an eight of an inch difference in the size makes quite a difference in the drilling time. The size of the bit or its sharpness affects the speed every time a blow is struck. When a drill is striking 200,000 blows per day these little differences count up to a great deal every day, to say nothing of months or years. A great point is to keep the machine pounding every possible minute of the time; lose as little time moving and changing as possible. The rule is to have the bits as thin as possible up to where they begin to make cornered holes, in which case the remedy is to thicken the bit $\frac{1}{16}$ inch or more. If the + bit rifles the holes, try the × shape. If the drill sticks, it is a thousand to one that the trouble is with the bit, or in the hole, and not in the machine. See that the corners are dressed well back where the side of the bit touches the wall of the hole, so that the rubbing surface is small. A dulled bit often takes twice as long to get down as a sharp one, and a good driller can accomplish twice as much as a poor one by

* Excerpted from the new catalogue of the Ingersoll-Sergeant Rock Drill Co., which contains a large amount of practical information respecting the use and care of rock drills.

making his moves and changes quick, keeping his bits sharp, and giving the machine its fullest stroke without striking the head. Keep the hole clean, the pressure high and dry, and the machine well oiled, and every last quarter of an inch stroke, so the piston is almost "nipping" the head every blow, unless in seamy or treacherous rock.

It is frequently quite as difficult to drill a straight hole as a round one. The shape of the bit has something to do with the alignment of the hole. It is an invariable rule that the edge of the bit should never be tapered in rock of uneven or irregular formation. The marble bit is of no use, except in a material like marble, which is uniform. It is obvious that with a tapered bit passing through a flint seam or other irregularity in rock, the tendency would be to glance, and this would result in "running of the hole.

Where drill holes tend to run out of line, the bit should invariably have a straight edge, that is, at right angles to the axis of the drill steel. It makes no difference whether the drill is a + or an × bit, so far as the alignment of the hole is concerned. In some difficult places where the hole passes through soft spots or seams running diagonally across the hole, it is advisable to upset the steel for a distance of about 6 inches above the bit. In other words, the steel should be very nearly the full diameter of the bit for a distance of about 6 inches at the bottom. The purpose of this is, that the steel may be guided by the wall of the hole, thus preventing "running" until the pocket or seam has been passed. This is readily undersood when it is known that the steel used with percussive drills is usually about 1 inch diameter octagon with a bit of about 2½ inches diameter; thus there is a space of about three-quarters of an inch between the steel and the drill hole, and should the condition of the bottom of the hole be such as to tend to thrust the bit to one side, it will gradually work the steel up against the side of the hole, and will result in a crooked hole, which will give trouble through binding and sticking. If the bar of steel were nearly equal in diameter to that of the bit, it would, as it were, force the hole to run straight. It will not do, of course, to carry so much weight of steel; hence, where trouble is met, it is best to upset the steel at the bottom.

In the ordinary course of drilling, the runner sometimes finds that his hole is going crooked, and, without waiting to get a special piece of steel, he attempts to pass through the obstruction. The first thing to do is to reduce the speed of cutting. This is done by either throttling the steam, shortening the stroke of the drill, or by dulling the bit; but whatever is done, it is necessary to "go slow" with the drilling. An effective means by which to prevent "running" is to pull out the steel and throw some iron filings, or small pieces of iron in any shape, into the hole, then put in the steel and go ahead. This not only reduces the speed of cutting, but the pieces of iron are thrust into the softer place, and thus the bit cuts through the obstruction and keeps the hole in line.

Let us assume that a cobble stone of the size of an egg or larger is encountered by the bit in the line of the hole, but a little to one side of the centre. Obviously, as the flange of the bit strikes this obstruction, it will be thrown off at a tangent and will gradually cut away the side of the hole farthest from the cobble. It is now simply necessary to drill a few inches more of the hole, without losing the line, and a few pieces of iron, (or even a nut thrown in the hole, will retard the "running" until the bit cuts through the obstruction.

A drill hole will sometimes "run" in a most unexpected manner, and in rock of uniform texture. In a case of this kind, the runner should at once stop his machine and see if his bit is in good shape. Sometimes one of the flanges breaks off and serves the same purpose in throwing the steel out of line as though a "hard head" was encountered. If the broken piece is large, it will sometimes get in one corner of the hole and give considerable trouble, even after the bit has been repaired.

It is of much importance that the hole be well started, that is, it should be started straight. In stone quarries, the mouth of the hole should be preserved at about the diameter of the hole, and not cratered or broken. This can be done by starting with a light blow and a short stroke, lengthening the stroke and the force of the blow after the hole has been made a little deeper than the length of the stroke.

The machine should be oiled often, and good oil used. The driller should have a system of oiling every time a certain number of feet are drilled. This varies with the rock, but an observant driller can soon learn how often to oil. "Little and often" should be the rule.

System of "Long Wall" Used in Northern Illinois Coal Mines.

By G. S. Rice, E.M.*

The system of mining which is to be described has been developed by the special conditions of the "third vein" of the northern Illinois coal field. This "third vein" is so called because usually third from the top, but geologically it is No. 2, numbering from the bottom.

In this district the other seams are only occasionally developed, and are worked in but few places. The "third vein" is very permanent and uniform, and is workable through the large district north of the Illinois river, and its annual output is between three and four million tons. The coal is a moderately hard bituminous coal of good quality; in fact, one of the best of the Illinois coals, its actual evaporative power being eight to nine pounds of water per pound of coal under a good boiler. The thickness of the seam is from 2 feet 10 inches to 4 feet, but the greater area only varies from 3 to 3½ feet. While the "third vein" is somewhat rolling locally, the general plane is nearly horizontal, having but a slight raise toward the outcrop at the north.

The coal is underlain with sandy fire-clay, which, at times, is so sandy as to be very hard. The roof is a light drab colored shale of fine texture, called by the miners "soap stone," from its soapy touch. It is of this character for 10 or 12 feet over the coal. Above that, bands of slate are interspersed with the shale until the upper coal seams are reached about 150 feet above. The total cover above No. 2 vein varies from 100 to 500 feet in thickness in going from the eastern to the western part of the northern district. The surface is rolling prairie. The sand and gravel drift, often several hundred feet thick in the western portion, contains much water, but the shale strata, as a whole, is not fissured or broken by the long-wall working, and so the mines are quite dry, even in the case of one mine which passes underneath the Illinois river.

The only exceptions to dryness are in mines at Braceville, which is near the outcrop. There the solid covering is thin, and in a few mines of that neighborhood the roads have to be corduroyed.

In selecting the position of a shaft, in most any part of the "third vein" district, there is usually no natural obstruction to prevent its being placed in the centre of the given tract. Besides the central hoisting shaft there must be an escape shaft, the present State law says 300 feet away. This distance may be lessened with the permission of the mine inspector. This is usually granted for the long-wall system, as it would be an unnecessary hardship to require such a great distance between the shafts, on account of the large pillar which it would necessitate.

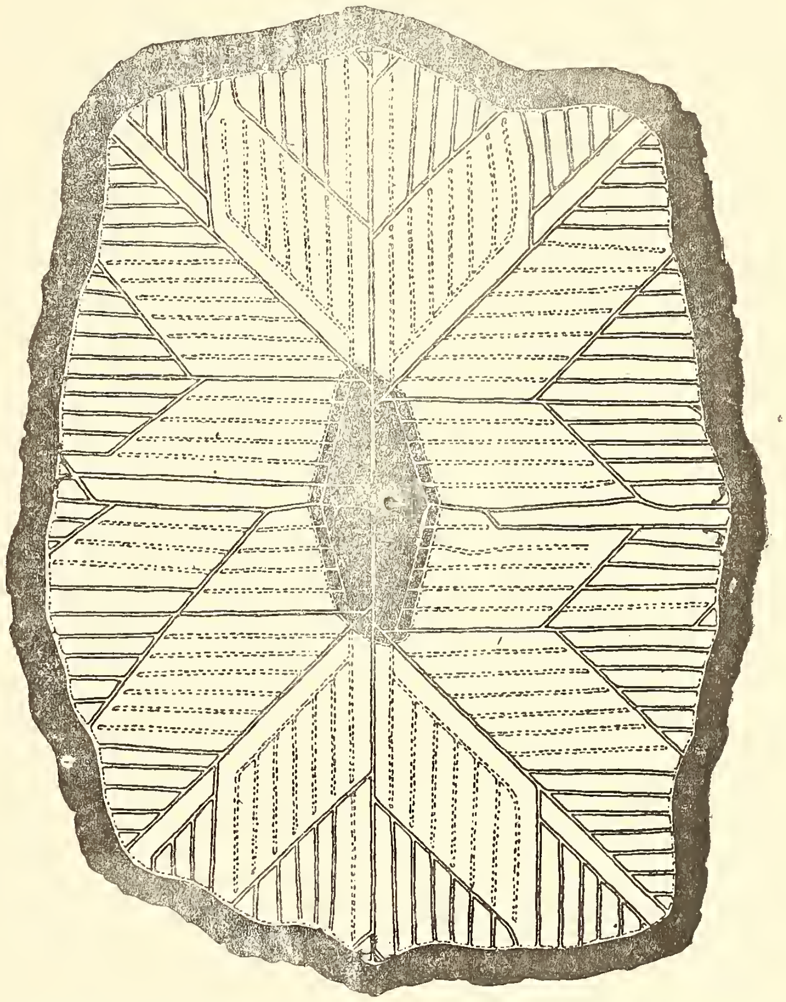
* School of Mines Quarterly.

Having selected the position of the shafts, the next point to determine in the planning of the mine is the size of the shaft pillar to be left. Of course this will depend chiefly upon the depth of the shaft, and the nature of the material gone through. The danger is in making the pillar too small, and in a number of cases there have been bad results following this mistake.

Observation of the shaft pillars of mines now open, leads to the conclusion that the strata of this district require, for a safe pillar, that its minimum diameter should be not less than the depth of the shaft. On the other hand, some advocate leaving no pillar at all, expecting that the whole shaft will sink so gradually and evenly that no danger will result; but the writer believes that the risk of racking the shaft is greater than the advantages that might be gained in more quickly opening the long-wall face. The usual plan of the district is to make the shaft pillar diamond-shaped, the "main bottoms" (termini of the main entries) occupying the long diameter. The escape is placed near the line of the short diameter; and it has been usual in the past to make it about 100 feet away from the main shaft.

After the shafts have been sunk, and connection has been made by driving headings from one to the other to establish a current of air, the "main bottoms" are pushed forward. If the diamond lies north and south, these will be the termini of the

Fig. 1



"main north" and "main south" entries. For a mine which is to have a large output, the "bottoms" are double-tracked for 250 feet on each side of the shaft, and, if practicable, are made with a down grade toward the shaft. These grades cannot always be established at once; the mine must be developed sufficiently to find how the seam is running. It may be necessary in some cases to lower the shaft if it is found that it has been sunk on the hill of a seam. At the end of the switch of the double track, the entry is narrowed to single track width, and just beyond two entries are turned off, one 45 degrees to the left, the other 45 degrees to the right, with an interval of about 40 feet between them. These form what are called "main 45 degree" entries, and run on the diagonals, so to speak, of the tract.

After the latter four entries have advanced about 30 feet, from each an entry is turned off at 45 degrees to run due east or due west respectively, and these complete the main permanent entries, making ten in all. From the east and the west entries, entries are turned and directed towards each other to block out the shaft pillar. Single entries are usually used in blocking out the pillar, but there is much difficulty in airing even when boxes are used, to carry the air to the face, and if the pillar is large, it becomes very severe on the miners.

A better way with large pillars is to have double entries with "cross-cuts" between, spaced at the right intervals for room-roads, then, connections having been made all round the shaft pillar, all is ready to begin the long-wall face at once from the side of the outer block entry.

When the blocking-out entries are single, the rooms are started narrow for a certain distance, then are broadened till they meet and form a continuous face around the block. Still another plan is to use a broad entry, packing on each side of the roadway, and starting rooms off it at once. This plan was used at the Ladd mine (see Fig. 1), where the width of the entry or room was 33 feet. The method was successful, except for a difficulty in airing, in spite of the air-boxes.

The spacing adopted for the branch roads in this district is 42½ feet from centre to centre of road, measuring at right angles. This makes an even 60 feet, when measured along the 45-degree entries, from which all the room-roads are afterward turned. Although not properly "rooms," the branch roads are so called locally, and we use this term in describing them.

Two miners work in each room in "getting" coal. They first prop or "sprag" the coal-face, then undercut the coal in the fire-clay to a depth of from 16 to 20 inches;

to do which the miner must lie on his side. The sprags are then knocked out, letting down as long a strip of coal as was undercut. At the beginning of the "long-wall," before the roof weights down the coal, the undercutting is hard, and, indeed, where the fire-clay is very sandy, the cutting may have to be done in the lower part of the seam itself, and the coal require to be wedged down.

The room-track is laid up to within five or six feet of the face, and the car is brought in as close as the brushing will allow. The track is in the middle of the ground 42½ feet wide, as already mentioned) apportioned to each pair of miners. The coal has to be carried or rolled along the face to load it into the car. After the coal has been loaded out walls are built up to the roof on either side of the roadway, and to within a couple of feet of the face. The walls are built with the rock taken down in the roadways to give height. This is called brushing. The method of doing it is, to carry the face of the brushing full thickness and up to a bedding plane, cutting with picks at the sides and pulling down the slabs.

Before the mine is well started, there may not be enough rock to build the walls and fill the "gobs;" in that case, soft-timber "cogs," which are sticks of timber laid log-cabin style, must be built. After the mine is well opened there is, usually, too much rock; and in some mines it averages one car of rock to every four or five of coal that must be taken out of the mine. Behind the walls, or "buildings," which must be six feet thick, are the "gobs," as they are called, which are filled as nearly as can be with the clay cuttings. If none, or not enough rock is at hand, timber cogs must be put in, for, in this system of long-wall it is very essential that the roof be supported evenly all over; if it is not, the weight is taken from the face, and also the sides of the entries are liable to be pushed in. Where other supports than clay or rock are used, they must not be too rigid. This is the object of the soft-wood cogs, which yield in much the same proportion as the walls and gob-filling.

After the main entries have progressed about 210 to 270 feet, depending upon local position, "cross-entries" are turned at 45 degrees. These cut off the room-roads, but new ones, off the last entry, are started at the same intervals, that is, 60 feet measured along the entry. The distance between the "cross-entries," or in other words the length of the room-roads, is determined by the rapidity with which the roof settles. This varies somewhat in different parts of the district, as it is necessarily proportional to the overhead weight; but the room is made as long as possible, just so that it does not require additional brushing to make headroom for the mule and loaded car before being cut off and abandoned.

The roof settles most in the first few months, but it is several years before it is entirely settled, by which time the gob has been squeezed down to one-half or one-third its original thickness.

The cross-entries themselves are cut off by the cross-entries started further in, thus making large diamond-shaped areas of "gobs," untraversed by open roadways; for as soon as a roadway is abandoned, it, in a few months' time, falls from the roof and the squeezing in of the sides fill it up.

If the mining conditions are at all equal throughout the mine, the form taken by the long-wall face is that of a rough circle, and on this account the system is sometimes called "the circular long-wall."

This "third vein" is quite free from strongly-marked slips or faces; and as it makes no difference in its mining what direction the work may progress, provided the face has no sudden bends, which would take off the necessary roof weight, the circular form is of no disadvantage. The roof is also very free from slips, and vertical cracks or joints, until the coal has been mined below it; but when the coal is brought down in a long strip, it marks the roof just where the break of coal has occurred and along these marks the roof afterwards breaks. These "breaks" seem to run up indefinitely, and oftentimes they can be followed up to the "black slate," 8 or 10 feet above. This peculiarity has had a marked influence in adopting the system of mining. When the "breaks" do happen to run parallel with the course of an entry, there is endless trouble from the slabs dropping out. The roof is apt to cut away over the side walls, and then, the only thing that can be done is to fill the top with timber. This, of course, is expensive, and were it the condition prevailing throughout the whole mine, would prevent the commercial success of the mine.

On the other hand, if the breaks run across the entry, pieces may splinter off, and there may be a festooning down of these pieces where there is no timber; but they interlock overhead, and there is nothing like the difficulty in keeping the entry in condition. From this, it is evident that it is necessary to have the roadways head on to the coal-face as nearly square as possible. The 45 degree system more nearly allows this than any other arrangement of roadways; and indeed, all of the other systems, both long wall and room and pillar, that have been tried in this seam, have been unsuccessful.

The mode of ventilation is very simple. Usually, the hoisting shaft is made the upcast, and one compartment of the escape shaft is made the downcast. The air is split at the bottom of the downcast into two currents, running east and west, respectively, in the example selected. When they reach the face they split again, moving north and south. The currents travel around the face of the workings, each having a quarter-circle to go. They come together again at the heads of the north and south entries, respectively, and passing to the hoisting shaft escape upwards. It requires but a few doors, which are placed near the main bottom, to make these currents, and as the splits are of nearly equal length, no regulators are needed. The ventilation is very effective, as fresh air is brought to just where needed, that is, along the face where nearly all the men of the mines are at work. Entries other than those mentioned get sufficient air from leakages and opening of the doors to let the cars through.

One objection that this long-wall system has, in common with all long-wall systems with continuous faces, is, that in "opening up," it often takes a year or two to reach the full capacity of the hoisting and loading plant, and when that has been reached, the face keeps on getting larger and larger until at last some sections of the mine have to be closed. However, where the shaft is shallow, instead of temporarily closing a portion, it is usual to distribute the men more, having but one in each room; and, when a certain limited area has been worked, say 160 acres, it is considered cheaper to sink a new shaft and move the plant rather than to keep open a large number of entries, with the expectation of having to re-open those parts of the face which had temporarily to be shut down.

Hitherto most of the mining has been done in the eastern part of the field where the mines are all shallow, most of them under 100 feet in depth. But now, mining has begun in the north-western part where the seam is deeper and overlaid with wet drift. There, since shafts are expensive to sink, they must be made to work out large territories, which can be accomplished with mechanical haulage. At present, haulage is done entirely by mules, in all the "third vein" mines and perhaps more cheaply than could be done by mechanical means, as the roadways are many and distances short.

Payment to miners is made according to the tonnage of lump coal they mine and load out, which is about 80 per cent. of the gross weight of the coal. The price in the eastern part of the field is 87½ cents in summer and 90 in winter. In the western part it is 5 cents less for both seasons. This is a differential allowed the operators to offset the extra railroad haul to Chicago, which is the largest market for this field. The miner, for the price paid him for lump coal, loads out the fine coal, and must also carry 18 inches of brushing in the roadway, build the pack-walls, fill the gobs and load out the surplus rock. His items of expense, are shovels, picks, a small monthly smithing charge, and oil for his lamp. With steady work for both miner and mine, which is essential to the fullest success of the long-wall system, a good miner can get out four or five tons of lump per day. The average of good and bad would be three tons per man, which makes good wages.

The present difficulty, however, is over-production of coal. Too many mines have been opened for the market and as a consequence, the mines for several years have averaged little over half time, and the earnings of men and mines have been small.

FIG. 2

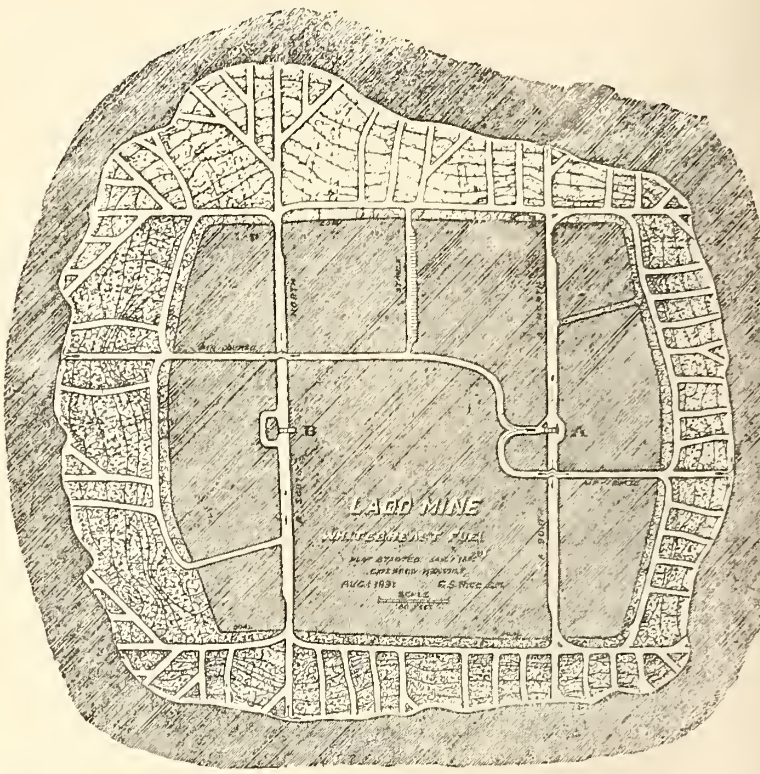
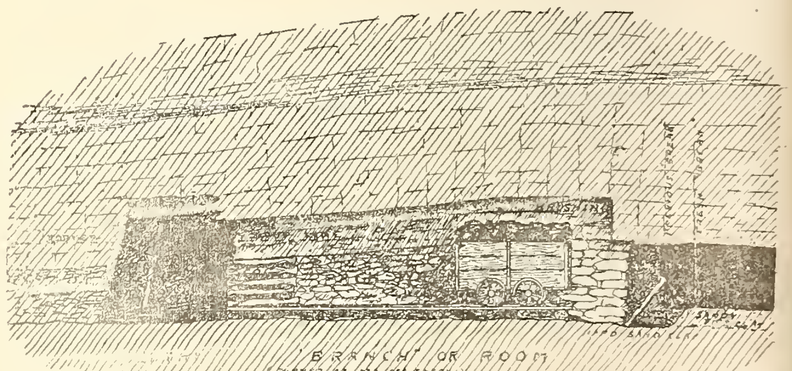


FIG. 3



One trouble that not working each day entails, is, that the careless miner does not load out all his fine coal, for on the days the mine does work, he wishes to load out only lump coal as that is all he is paid for. The fine coal if left in the gobs in any considerable quantity, may be ignited by the sulphur in the form of iron pyrites, which here and there is found in small streaks in the coal, and has not been sent out, as it should be, with the rock. A fire in the "gob" is an awkward thing at the best. It must be reached promptly by cutting a passage right to the heart of the fire, and loading out the burning stuff. If the fire should be neglected, it would soon be beyond control, would get into the roof, which contains enough bituminous matter and specks of the sulphur to fire, and the whole district would have to be abandoned. Double fire-walls of brick with sand between would then have to be erected in all the roadways round about.

In one of the mines of the field, such a fire has been smoldering for years through a considerable district of the mine.

Fig. 1 shows a typical mine of the district. The full lines show the working roads, the dotted lines the roads that have been cut off and therefore abandoned. In this particular mine the conditions were highly favorable, and it was noted for the exceptional rapidity of development, and working out of the coal in the tract assigned to it. The narrow-work around the shaft was completed in two months. The long-wall face was started with thirty rooms. During the first month the largest output in a day's run was 300 tons, but nine months later it had reached 1,038 tons. The highest record for a day's run of ten hours during the whole life of the mine was 1,900 tons gross weight, or 1,702 tons of lump. In one month with twenty-four working days there was hoisted and loaded 25,057 tons of lump coal. The life of the mine was comprised in 766 working days, during which about 175 acres of the coal seam were mined out, giving 688,619 tons of lump coal.

Fig. 2 shows a map of Ladd mine eight months after the narrow entries had reached the boundary of the pillar, and the several isolated long-wall faces had just started. At the end of four months a continuous long-wall face had been formed around the block. In the drawing, the lines shown circling around the pillar more or less parallel, are the faces of the long-wall on the first of each month. Those parts of the mine in which the fire-clay under the coal was soft enough to permit mining in it are readily observable, as the places where the face is farthest advanced. This mine is a double one, that is, it has two hoisting shafts. The roads are planned to serve either shaft, so when the output exceeds the capacity of one shaft the other can also be used. The average capacity of both shafts together should be not far from 3,000 tons of coal, gross weight. The pit-cars at this mine hold about one ton, gross weight. This is a somewhat larger capacity by 400 or 500 tons than the pit-cars have in the eastern part of the field. The engines hoist a car through the 500 feet to the top landing in ten seconds. Four cars per minute can be hoisted by the engine at either shaft. The ventilating is done by 24-foot forcing fan with straight paddles and spiral-expanding casing.

Fig. 3 shows a profile sketch of the head of a roadway in the mine, illustrating the method of propping and undercutting the coal face, and the settlement of the roof further back.

The settling of the roof is appreciable at the surface even when the seam is at a depth of 400 or 500 feet; but so gradual is it, and without vibration, that the deep mines have caused no trouble in going under railroad tracks, and even under brick buildings, as has been done at La Salle.

Mining Explosives.

By Prof. Vivian B. Lewis, Greenwich, Eng.

(Paper before Fed. Institute of Mining Engineers.)

Last winter the writer had the honor of delivering a course of Cantor lectures efore the Society of Arts on the subject of "Explosives and their modern Development," and in the last lecture of that course dealt with mining explosives, and showed, to his own satisfaction at any rate, that all explosives which give rise to carbon monoxide as a product of their combustion, ought to be strictly tabooed for use in mines, not only because of the risk of injury to health and life from the poisonous nature of the gas, but also because even small traces of carbon monoxide render mixtures of coal dust and air highly explosive, a point which has, he thinks, been entirely overlooked in all experiments upon this most important subject. In reviewing the properties of the various mining explosives now in use, it will be convenient to classify them according to the way in which they produce the gas which gives the explosive effect. Class I.: Explosion due to simple combustion, as in the case of blasting gunpowder. Class II.: Explosion due to detonation of the whole of the explosive, as in nitro-glycerine, nitro-cotton, and some Sprengel explosives. Class III.: Explosion due to detonation of part of the explosive and combustion of the remainder, as in carbonite, westphalite, &c. This may at first sight seem to be an awkward and unreasonable method of classification, but inasmuch as the claims of any explosive for mining purposes must in the first place be based on its safety as regards the non-ignition of explosive mixtures in the workings of a mine, and as this in turn largely depends upon the way in which the explosive generates its force, the writer prefers to adopt it in view of the considerations he wishes to bring before the members.

The most characteristic types of the first class are ordinary black gunpowder and blasting powder, both mixtures of the combustibles carbon and sulphur with potassic nitrate as the oxidizing material, the great difference between the two being that whilst in ordinary gunpowder the proportions are so arranged as to give great heat energy to the explosion, in blasting powder a slight lowering of temperature is obtained by increasing the proportion of sulphur present. and reducing the oxidizing material, the result being that during explosion, the products of combustion although increased in volume, consist largely of imperfectly oxidized bodies which are themselves inflammable.

Composition of Powders.

	Gunpowder.	Blasting powder.		
		England.	France.	Italy.
Potassic nitrate	75	65	62	70
Sulphur	10	20	20	18
Charcoal	15	15	18	12
	100	100	100	100

Products of Combustion.

	Gunpowder. Fine grain.	Mining powder.
Carbon dioxide	50·62	32·15
Carbon monoxide	10·47	33·75
Nitrogen	33·20	19·03
Sulphuretted hydrogen	2·48	7·10
Marsh gas	0·19	2·75
Hydrogen	2·96	5·24
Oxygen	0·08	0·00
	100·00	100·00

Gunpowder itself is practically never used, and the only word that can be said in favor of the blasting powder is that it is cheap. It is absolutely unfitted for use in coal mines, and its abolition would do away with more than three-quarters the number of deaths annually returned as being caused by mining explosives. The great danger attending its use, however, consists in the combustible nature of the products evolved during decomposition, a factor in coal mine explosions which I venture to think cannot be overrated. On firing a charge of 1¼ lb. of blasting powder, over 3 cubic feet of combustible gas, consisting chiefly of carbon monoxide, would be produced, and this when mixed with pure air, would give over 10 ft. of an explosive or at any rate rapidly-burning mixture, and experiments which have been made upon the effects of fire-damp and dust combined in causing colliery explosions show conclusively that even when firedamp is present in such minute quantities as to form a mixture very far removed from the point of explosion, it makes the mixture of coal dust and air highly explosive; and traces of carbon monoxide will do exactly the same thing when the air is laden with coaldust, whilst the temperature of ignition is lower than with methane, so that when the air of the mine is charged with coaldust, the probabilities are that a very large volume of explosive mixture is formed by the rapid escape of the products of combustion into the dust-laden air, and this being ignited either by the flame or by red-hot solid products driven out into it by a blown-out shot initiates a considerable area of explosion. As the explosion takes place, and as the carbon monoxide already produced is oxidized to carbon dioxide by the action upon it of water vapor present, and also by its direct combustion with oxygen, the hydrogen of the water vapor is set free, whilst the heated coaldust also yields certain inflammable products of distillation to the air, and partial combustion of the coal dust gives a considerable proportion of carbon monoxide once more, and this driven rapidly ahead of the explosion, forms, with more coaldust and air, a new explosive zone, and so, by waves and throbs, the explosion is carried through the dust-laden galleries of the mine. In this way any explosive which generates inflammable products of incomplete combustion is unsafe, and should never be used even in mines where firedamp is unknown, as such explosives are quite capable of setting up an explosion with coaldust alone. A still greater danger arises if any trace of firedamp exists in the mine, as this, together with dust, provides an already explosive atmosphere, whilst the products evolved by blasting powder are capable of playing the same part as sulphur on a match, and causing ignition of the explosive mixture. Firedamp, as has been shown by the numerous experiments made since Sir Humphry Davy's memorable researches, is not easily inflamed, and explosive mixtures containing it not only require a temperature of over 1,200 degs. Fahr., but require this temperature to be applied for several seconds, sometimes as much as ten, before ignition takes place. This phenomenon is due to the absolute ignition point of methane being extremely high, far higher than the temperature at which it decomposes into hydrogen and acetylene, and the result is that at temperature such as 1,200 degs. Fahr., decomposition of the methane molecules first takes place, and the liberated hydrogen then igniting raises the mass to the true ignition point of the methane. This dual action requires an appreciable time, and it is this alone which gives the comparative safety in mines where any trace of firedamp exists. If we take the temperature developed by the more prominent explosives, we find them to be far above the ignition point of explosive mixtures of methane and air for a steadily applied heat.

	Degs. Cent.	Degs. Fahr.
Blasting gelatine	3,220	5,828
Nitro-glycerine	3,170	5,738
Dynamite	2,940	5,284
Guncotton	2,650	4,802
Tonite	2,648	4,7984
Picric acid	2,600	4,712
Roburite	2,100	3,812

Whilst the ignition point of explosive mixtures of the various combustible gases which could be present in the working of the mine, either produced by the use of improper explosives, or liberated by the coal, are about:—

	Degs. Cent.	Degs. Fahr.
Hydrogen	620	1,148
Methane	660	1,220
Ethylene	580	1,076
Ethane	605	1,121
Butylene	540	1,004
Carbon monoxide	640	1,184
Ordinary coal gas	648	1,198·4

It is manifest, therefore, that if the products of explosion escaped into the mine at this temperature, any explosive mixture in the mine must be ignited. This temperature, however, only exists whilst the gases are under the pressure generated by the explosion, and directly they blow out into the workings, expansion instantly cools them below the temperature necessary to bring about the changes leading to the ignition of mixtures of methane and air, or methane, air and coal dust. It is important that it should be fully realized that the factor of safety entirely depends upon the retarding influence of the chemical changes necessary before the ignition takes place, and it is the absence of this with explosive mixtures of other gases that constitute a real source of danger. Fortunately the inflammable constituent of pit gas is practically only methane, and with the use of proper explosives, *i.e.*, explosives which can be completely detonated, and which give neither combustible products nor burning solids on explosion, a very fair degree of safety is attained. Directly, however, inflammable gases other than methane are introduced, the margin of safety disappears, and with explosive mixtures which contain carbon monoxide, hydrogen, or ordinary illuminating coal gas, the point of ignition being the true one, no time is given for the products of the explosion to cool themselves down below the ignition point, and the gaseous mixture is fired. It will always be noticed that in making trials with various explosives where pit gas is used for the mixture in which the explosive gas is fired, ignition is rare, whilst with mixtures of air and coal gas, ignition is the rule rather than the exception, and surely no one can believe that this depends upon the few degrees higher point of ignition which the methane is supposed to possess, and it is this obliteration of the factor of retarded ignition which makes it imperative to discard any explosives generating combustible products of incomplete combustion for use in fiery mines. It is also evident that the more rapid the explosion the safer will it be, and no explosive should be used which relies upon simple combustion either as the primary or secondary principle in its action. A still greater source of danger found in the explosion of blasting powder is the excess of sulphur which it contains, and which during explosion shows its presence by the evil odour of the escaping gases which contain over 7 per cent. of sulphuretted hydrogen, whilst under certain conditions traces of carbon bisulphide are alzo produced. As has been already pointed out, the ignition point of carbon monoxide is about the same as ordinary coal gas, and may be taken as being 1,134 degs. Fahr., but the vapour of carbon bisulphide has an extremely low point of ignition, and the admixture of only 3 per cent. of its vapour with carbon monoxide lowers the igniting point to below 400 degs. Fahr. Blasting powder and other explosives of the first class should unhesitatingly be discarded, not only as being unsafe in use, but also as deleterious to health, the products of incomplete combustion all having a distinct toxic effect on the system.

Taking now explosives of the second class, we come to nitro-glycerine, nitro-cotton, and some of the Sprengel explosives, and the distinctive characteristics of this division is that all the members of it are capable of complete detonation, provided always that the right sort of detonator is employed. Nitro-glyceriue, which first inaugurated the modern era of high explosives and commenced its career as blasting oil, stands apart from all other nitro compounds, owing to the fact that it contains more oxygen than is necessary to complete the oxidation of the carbon and hydrogen found in its molecule.

Nitro-glycerine. Carbon dioxide. Water. Nitric oxide. Nitrogen.

$$2[C_3H_5(NO_3)_3] = 6(CO_2) + 5(H_2O) + NO + N_5.$$

The result being that it evolves no combustible products, whilst its rapidity of detonation would make it the safest and best of all the blasting explosives were it not for the danger inseparable from its physical conditions and sensitiveness to shock. Some of the best of the nitro-glycerine class of explosives, such as blasting gelatine, are amongst the worst offenders as regards the evolution of combustible products of combustion, as the deficiency in oxygen of the nitro-cotton employed is not made up for by the excess present in the nitro-glycerine used. Nitro-cotton alone has from time to time been used for blasting work, but in this case we obtain the maximum amount of combustible products. Several explosives have been made on the principle of mixing nitro-cotton with oxidizing materials, but the only one of these still in the market is tonite, in which the generation of carbon monoxide is reduced by mixing the nitro-cotton with mineral nitrates. Such mixtures, however, give rise to a residue of fused salts, which, if blown out into an explosive atmosphere, would be extremely liable to ignite it, whilst although the combustible gases evolved are reduced in quantity they are not done away with. Besides nitro-glycerine and nitro-cotton, such of the Sprengel explosives as are capable of complete detonation come under this group. The Sprengel explosives have been largely used for blasting purposes, both abroad and in this country; those used here consist of mixtures of nitrated hydrocarbons and ammonium nitrate. Roburite, introduced by Dr. Carl Roth, is a simple mixture of nitrate of ammonium with chlorinated meta-di-nitrobenzol. The ammonium nitrate is first dried and ground, then heated in a closed steam-jacketed vessel to a temperature of 80 degs. Cent., and the melted organic compound is added, and the whole stirred until an intimate mixture is obtained. On cooling, the yellow powder is ready for use, and is stored in airtight canisters, or is made up into cartridges. Owing to the deliquescent nature of the ammonium nitrate, the finished explosive must be kept out of contact with the atmosphere, and for this reason the cartridges are waterproofed by dipping them in melted wax. This mixture is not exploded by ordinary percussion, firing, or electric sparks. If a layer of the explosive is struck a heavy blow with a hammer, the portion directly receiving the blow is decomposed, owing to the heat developed, but no detonation whatever takes place, nor are those portions of the substance around the spot in any way affected, whilst if roburite be mixed with gunpowder and the gunpowder be then ignited, the latter explodes and scatters the roburite without firing it. The roburite can only be exploded by a specially powerful detonator, and on decomposition the gases evolved contain no combustible constituents, but consist only of carbon dioxide, water and nitrogen, with a small trace of hydrochloric acid gas, which is at once condensed by the large volume of water vapor evolved, and gives rise to no inconvenience. Ammonite is another explosive of this class, which is manufactured from ammonium nitrate and dinitronapthalene, these substances being blended in the proportions to give as the products of combustion carbon dioxide, water vapor and nitrogen, but during the decomposition taking place, probably some more complex action occurs, as small traces of ammonia can generally be detected. Bellite consists of a mixture of dinitro-benzene with ammonium nitrate, the latter being kept rather in excess. Securite consists of ammonium nitrate and dinitro-benzene, but from the proportion of nitrate used it is probable that carbon monoxide is produced. These cartridges are coated with nitrated resin, in order to protect them from the action of the atmosphere. There is no doubt but that this group of explosives approach more nearly to real safety explosives than any which have yet been introduced. The low temperature of explosion secured by the use of ammonium nitrate, the absence of any combustible products of decomposition—except perhaps with securite—and the fact that both the oxidizing material and the combustible are capable of complete detonation with a sufficiently powerful fuse, give these explosives enormous advantages over any others to be obtained, whilst they are absolutely safe in handling. The safety of the Sprengel explosives in handling and use is to a large extent dependent upon the fact that when the mixture of ammonium nitrate and the nitrated organic body is ignited by ordinary flame, the ammonium nitrate requires a large amount of heat for its decomposition, in order to render the oxygen which it contains available for the combustion of the carbon and hydrogen in the organic body, and the temperature of the burning substance is not sufficiently high to propagate this action throughout the mass, the result being that to cause continued combustion you must have a continuous supply of heat, or the flame first started simply dies out. The effect of this is that in handling, such bodies are practically non-inflammable, and when they are made to explode by detonation, a more than usually powerful detonator has to be employed, so that although with nitro-glycerine mixtures a charge of 7 grains of mercuric fulminate is amply sufficient to produce detonation, such a body as roburite needs at least 15 grains. Moreover, when detonation has been produced, the amount of heat absorbed by the decomposition of the ammonium nitrate causes a very considerable lowering of the temperature of explosion. To the writer's mind it is an absolute *sine qua non* that in an explosive mixture for mining work, all the constituents should be capable of detonation, and the reason for this is that under these conditions the shock of the detonator resolves both the oxidizing and combustible bodies into their respective molecules, and that these then recombine into the gaseous forms which give the explosive force, the whole action being practically instantaneous, and causing the projection of the hot products with such velocity as to give no time for the decomposition of the methane in the pit gas, and the ignition of its constituents. In order to obtain the requisite rapidity of explosion to ensure safety as regards the ignition of gaseous mixtures in the pit, the reacting portions of the explosive must be in the condition of molecular division, and for blasting purposes this can only be obtained by complete detonation. It is impossible to obtain safety by any attempt at mechanical division. An excellent example of this failure of mechanical means is to be seen in westphalite, which is made by mixing 95 per cent. of ammonium nitrate with 5 per cent. of shellac or resin dissolved in alcohol; the alcohol is driven off by heat, and the mixture is ground and made up into cartridges. In this mixture the resin or shellac cannot be detonated, and the presence of the inert material necessitates the use of a No. 9 detonator, containing 2.5 to 3 grains of fulminate, to explode the mixture, and when detonated the ammonium nitrate only is decomposed, and the simple combustion of the resinous matter by the products follows as a secondary reaction, with the result that the period of explosion is very sensibly increased, and the risk of the ignition of the pit gases becomes much greater. The resinous material undergoing combustion is also a source of danger, as, instead of being in a molecular state of division, the smallness of the particles is governed by the degree of fineness to which it is ground, and a blown-out shot would be accompanied by a shower of sparks of the burning resin. The fine condition into which it must be ground must also increase the troubles due to the hygroscopic nature of the ammonium nitrate. In deciding as to the relative claims of the other members of the Sprengel group, ammonium nitrate being common to all, the best will be the one in which the nitrated combustible is the most susceptible to detonation, as this reduces the chance of mis-fires or partial detonation as well as increases the rapidity of explosion, and the writer should expect the chloro-dinitro-benzol used in roburite to answer best to this requirement.

The third group of explosives consists of mixtures of the first and second groups, in which a body susceptible to detonation, and generally of an oxidizing character, is exploded and the products made to act upon a combustible. Westphalite is an admirable example of this group, but the most important member is carbonite, which consists of a mixture of about twenty-five parts of nitro-glycerine, thirty parts of nitrate of potassium, four parts of nitrate of barium, forty parts of wood meal, and one of carbonate of sodium. On detonation the nitro-glycerine is decomposed and combustion of the wood meal at the expense of some of the oxygen of the nitro-glycerine and the metallic nitrates takes place. There is no doubt that the admixture of so large a proportion of carbonaceous material reduces the temperature of the explosion, but it also makes it one of the worst offenders as regards the generation of combustible products, and if carbonite be exploded in an experimental bomb, the escaping gases can be ignited and will burn with a characteristic carbon monoxide flame, over 40 per cent. of the products of its combustion consisting of this gas. So far carbonite has come out in trials and in practice in a very satisfactory manner, but a blown-out shot in a dusty mine would be quite likely to lead to an explosion, whilst the fumes must be very injurious to health.

For the reasons which the writer has brought before the members, he thinks the selection of a safety explosive should be based upon the following points:—(1) The explosion must be due to detonation and not to simple combustion; (2) if the explosive be a mixture, both the combustible and oxidizing material must be susceptible of detonation; (3) the products of explosion must be non-inflammable and non-poisonous; (4) the explosive must be safe in handling as well as in action, and compounds of an unstable character which are liable to change should be avoided; (5) the temperature of explosion should be as low as is compatible with rapidity of action. The following table gives an idea of how far the explosives most in use comply with these requirements, and it will be seen that the Sprengel explosives occupy the foremost place:—

Mining Explosives.

Name.	How exploded.	Products of explosion. Combustible.	Non-combustible.
Gunpowder	Combustion	14	86
Blasting powder	"	42	58
Nitro-glycerine	Detonation	*nil*	100
Nitro-cotton	"	61	39
Gelignite	" and combustion.	7	93
Carbonite	" " "	41	59
Roburite	"	*nil*	100
Ammonite	"	*nil*	100
Bellite	"	*nil*	100
Securite	"	trace	100
Blasting gelatine	"	46	54
Tonite	" and combustion.	8	92
Westphalite	" " "	trace	100

Given an explosive which answers to these requirements, and using electric firing, with detonators containing sufficient fulminate unmixed with chlorate of potash, to ensure complete detonation, ought to reduce accidents from explosives to a minimum.

CORRESPONDENCE

The Slocan District, B. C.

The Editor:

SIR,—The district especially under consideration is that portion of the British Columbian Selkirks which lies between the Kootenay and Slocan lakes. Of this district, the mountains drained by the creeks flowing into the east side of Slocan Lake have, so far, been found to be the best mineralized. In the formations which surround the Carpenter Creek and its three branches, the great majority of the producing silver mines are situated. These are usually galena, silver bearing, within a calciferous slate formation, or in the near neighborhood of such rock. Some few mines carry dry ores of silver, but these are more often found in the granites or the crystalline rocks which make up the massive formation of this district. When so found, the silver occurs as native silver, ruby silver, sulphide of silver, grey copper carrying silver, and other combinations less readily determined.

In 1891 the first movement was made into this country, and this being before the last fall or "slump" in silver, caused some considerable excitement and progress. Since that time prospecting and development have gone steadily on, as there are here bodies of ore so rich that it still pays well to mine them.

This summer a large amount of work is being done towards increasing the ease of getting out the ore, whereby mines which formerly had to pack in supplies and pack out ore several miles, will now be able to construct tramways down to the railroads, or, at least, short waggon roads, thus making their mines more profitable, and producers all the year round, which was not the case before, for but little ore was shipped after the snow season of the winter.

Dealing more particularly with the ore-producing mines, the galena-silver properties take the lead, chiefly because they are of greater body and extent, giving more encouragement to mining companies to work permanently, but besides this, until the prospecting of the present season, the richer leads carrying dry silver ores and gold, had not been discovered.

Concerning the producing mines of the Slocan, tributary to the Nakusp and Slocan railway, the following is a quotation from the New Denver *Ledge*:—

"From the initial shipment of September 13th, till January 1st, 1895, the Slocan mines sent out over the Nakusp and Slocan railway:—

	Tons.	Valued at.
Alpha mine	771¼	$ 77,125
Mountain Chief	91¼	9,125
Slocan Star	1031½	103,150
Fisher Maiden	47¾	4,775
Noble Five	87	8,750
Minnesota Silver Co	15	1,500
Reco	42¼	4,225
Idaho	60	6,000
Last Chance	15	1,500

This does not include the heaviest shipments made by the Concentrator Co., of Three Forks, who handled some 6,000 odd tons during the winter.

Also, it will be seen that the values given above are simply nominal, being the customs valuations upon these ores which are shipped mainly to the Omaha smelters.

Besides these mines many small shipments were made from properties worked in a small way by the original locaters. Their output being heavily handicapped by the high rates for pack animals and feed.

Since May active work has been going forward in the opening up of this district by the extension and improvement of roads already built, and by the construction of the Kaslo and Slocan railway, a narrow guage line which taps the Slocan Star and Cody Creek group, and gives the ore an outlet by way of Kootenay Lake at Kaslo, twenty-five miles eastward. The C. P. R. also is now engaged in building an electric tramway from Three Forks to Sandon, to draw ore from the same rich mines.

The Concentrating Co., a Duluth syndicate, owning the Idaho and Alma groups, have this summer constructed a three-rail tramway some 7,000 feet long, by which to supply their concentrator, which has a capacity of 100 tons a day.

The now famous Slocan Star will also have a tramway and concentrator put up before winter, and in time most of the principal mines will find it necessary to concentrate some of their ore, which is of too low grade to pay under the present expensive shipment, and is thrown on the dumps.

Under the influence of the improved shipping facilities it is expected that this winter's output will be much increased, as the ores can be shipped and treated at the Tacoma smelters for $24 a ton, leaving a large margin for the expenses of getting it out, when it runs, as it usually does, from $100 to $200 a ton in silver with from 50% to 75% lead. These ores carry very little zinc and silica. They are usually handpicked and shipped in small sacks carrying between one and two hundred pounds. A sack sample being made and assayed in order to check the smelter's returns.

During the last three months much prospecting has been done along the creeks flowing into the Slocan Lake from the east.

This country is composed chiefly of granite with bands of other igneous rocks, and some masses of a quartzitic nature impregnated with iron. There is an absence of the limy slates characteristic of the galena-silver basins.

This formation carries dry ores such as contain native silver, silver sulphide, argentiferous grey copper, and other mineral combinations of silver not so readily determined. With these is usually a fair showing of gold and in some the gold is free and visible, but more usually it appears to be in combination with various sulphides.

The L. H. is a property which is highly mineralized with arsenical iron. This carries gold. Along the foot wall of this band of rock there occur pockets of arsenic; these contain silver up to 1,000 oz. a ton.

Upon Springer Creek and Ten Mile Creek, which flow into the lake near its southern end, are several very rich properties which carry native silver and sulphides to the value of over 1,000 ozs. to the ton, and over $100 in gold. These, however, have been found but lately, and it is for the future to show whether their early promise is carried out when actual mining begins. As far as can be seen at present they are true fissure veins, and being in the granite are likely to hold their size with some regularity.

These favorable locations have caused considerable excitement in the district but have failed so far to direct the attention of capitalists who steadily pour into the Rossland county.

Under the present mining laws the acquisition of claims is made very simple and easy. Any man holding a miner's certificate, (which costs $5), can locate as many properties as he desires, provided they are not, any two of them, upon the same ledge. Each location being 1,500 feet square. By this means many claims are recorded which will not justify the expense of their development, and such are termed "wild cats." Their value being nil until the expected boom comes along, when anything showing mineral appears to sell quite readily, as the present summer's experience around Rossland seems to show. These claims being held for one year under a light assessment of development work, excuse the speculation.

Nevertheless, out of the prospectors' assays made this summer at New Denver, of which there have been some 350 since June 1st, nearly 50% of those made for silver have carried over 100 ozs. in silver, some have shown nothing at all owing to the ignorance of the locator as to what constitutes ledge matter, and many have carried gold in quantities ranging from a trace to $150 a ton. These prospectors, as usual, are rarely able to bear the expense of the development of their claims, and yet hold them at somewhat high figures considering their undeveloped character. They are more readily dealt with by means of bonding the property, or selling an interest for cash, which latter means enables them to take out some ore, for which they can get the smelter returns and at the same time determine the character of the mine and its dividend-paying possibilities.

J. C. Gwillam.

New Denver, B.C., 20th August, 1895.

NOVA SCOTIA NOTES.

It is with the deepest feelings of regret that we have to record the death of Mr. J. M. Reid, late manager of the Oxford gold mine, at East Chezzetcook. Mr. Reid developed symptoms of consumption last year in consequence of which he had to give up the management of the Oxford mine. He then travelled to Colorado, California, and North Carolina, where he died. Mr. Reid was 31 years of age, and was manager of the Oxford mines for 10 years, during which time he made many friends.

A company is being promoted by Messrs. C. E. Willis and G. J. Partington to take over the Oxford gold mines. Mr. Partington is the resident manager and has started work already.

All previous records were beaten at the Mines office by Mr. F. W. Christie, who has taken up 860 gold mining areas in the neighborhood of Brookfield, Colchester Co. It is reported that these areas have been taken up for London people, who are interested in a cyanide process for extracting gold. No one is more anxious than ourselves to see a good strong English company operating in Nova Scotia, but we would like to see them in a good district or not at all, and we cannot say that we hail the venture with delight. Nova Scotia, through no fault of its own, has a bad enough name on the other side of the Atlantic. We do not think the investment of British capital in gold areas in the neighborhood of Brookfield, Colchester County, will be likely to improve it.

Mr. W. R. Thomas has relinquished the management of the Nova Scotian Gold Mines, at Montague, to take over the management of a copper mine at Puledo, in Portugal, for an English company. We congratulate Mr. Thomas, and feel sure he will be more in his right sphere now he has returned to copper mining.

Mr. George W. Maynard, M.E., of New York, has been in the province for some time investigating gold and iron properties. He is making a series of mill tests of the barrel quartz lead at Waverley, and is also examining iron properties at Middleton.

Mr. J. E. Hardman has resigned the management of the Tudor Gold Mining Co. at Waverley.

Mr. W. F. Libby still continues his success at the Brookfield (Queens Co.) mine. 648 oz. in three months is a very good record.

The Mining Society of Nova Scotia have taken a large room under the Queen Hotel, 107 Hollis Street. The room has been prettily fitted up and members appreciate the change.

Mr. A. A. Hayward has taken up 150 areas adjoining the Golden Lode mine in South Uniacke.

The Halifax *Herald* of Aug. 22nd is responsible for the following:—"From a correspondent in Port Morien the *Trades Journal* received a short account of a fatal accident which occurred on the Dominion Coal Co.'s railway at that place last Tuesday. Mr. Evans, the superintendent of the mine, was in the habit, so it is stated, of running the locomotive occasionally. On Tuesday, while handling the locomotive, something went wrong, and in some way Hector McLean, the brakeman, was killed. An inquest was held and the jury returned a verdict of manslaughter, and, as a consequence the superintendent was sent to jail."

It is proposed to organize a company to start a mill for the purpose of grinding the gypsum at Gay's River.

A suit for a large sum of money, nearly $700,000, has just been started in the Supreme Court by the American Trust and Loan Co. against the Eastern Development Co., who own the Coxheath copper mine near Sydney, C.B.

MISCELLANEA

The Safety of the Miner's Calling.—The disastous effects of occasional colliery explosions is apt to lead to the belief that the miner's calling is more dangerous than any other occupation. Official statistics, however, clearly prove the error of this assumption. On turning to the collieries, which are usually regarded as the most dangerous mines, it will be found that the amelioration of the lot of the collier in recent years, owing to the lessening of the number of accidents, is most gratifying. In the 10 years from 1833 to 1842 the average number of lives lost by accidents amounted to 4.1 per thousand colliers employed. In 1853 to 1862 this proportion sank to 3.4, in 1863 to 1872 to 2.0, and in 1883 to 1892 to 1.8, whilst in 1893 to 1894 the proportion did not exceed 0.9 per thousand. In other words, since 1833 fatal accidents have decreased 75 per cent. In metal mines the mortality from accidents has remained nearly stationary, and amounts to 1.3 per thousand. Thus the collieries with their firedamp and other noxious gases, their dust explosions, and their mine fires, present greater safety than metal mines. This apparnet anomaly is explained by the fact that in the small metal mines improvements are more slowly introduced and carelessness is more prevalent than in the larger well-managed collieries where there is constant supervision day and night.

It is still more remarkable to find that coal mining is less dangerous than many other avocations. The German official statistics show that the milling trade is just as dangerous as coal mining, for the lives lost by accidents averaged 0.9 per thousand millers employed. On railways and in breweries the deaths average 1.3 per thousand, while carters and warehouse men have a still higher average—1.5 per thousand. Coachmen are subjected to greater dangers, the accidental deaths being 2.0 per thousand whilst with men engaged on river barges the average is 2.1, and in sea-going vessels 2.2 per thousand. These figures, it must be noted, do not include fishermen, whose work is the most dangerous of all. The English statistics for 1883 to 1892 show that the deaths of sailors caused by accidents on steamers were 4.8 per thousand, and those of mariners and fishermen were 7.7 per thousand. Thus the collier working underground is eight times safer than his fellow worker on the sea.

Coal mining is a calling that brings little sickness in its train. Dr. Ogle, the eminent authority on mortality statistics, brings forward evidence to show that, if accidents are excluded, the mortality of coal miners only slightly exceeds that of the most healthy class of men, the agricultural laborers. Taking the years of age between twenty-five and forty-five, he gives the following comparative figures as the mean annual death rates per thousand living:—All males, 10.16; coal miners, 7.64; ironstone miners, 8.05; tin miners, 14.77; butchers, 12.16; plumbers and painters, 11.07; tailors, 10.73; shoemakers, 9.31; and agricultural laborers, 7.13.

As would naturally be expected, breathing bad air or working in constrained positions are frequent causes of disease among miners, and Dr. Snell contends that the disease of the eyes known as nystagmus is prevalent among colliers who have to work lying on their sides. It is curious to note that as regards tendency to insanity, miners favorably contrast with persons engaged in other callings. The recently published report of the commissioners on lunacy, show that for every 10,000 miners given by the census the annual average of admissions to asylums in 1889-93, did not exceed 4.4. In the case of costermongers and peddlars, who head the list, it amounted to 20.1; flannel merchants and cotton warehousemen come second, the proportion being 18.2; then follow physicians and surgeons with 15.8; chemists and druggists with 14.1; lawyers with 13.5 and architects, surveyors and builders with 5.9; whilst in the case of navvies and railway laborers the proportion sinks to 4.8. These figures are very curious, and the position occupied by miners on the list is most remarkable. The statistics are certainly encouraging, for they show that the coal miner's calling is a healthy one physically and mentally.—*Colliery Guardian.*

Silver Smelting in British Columbia.—By the decision of the Consolidated Kansas City Smelting and Refining Company to put in a large smelting plant at Nakusp, West Kootenay, the smelting industry may be considered as soon to be put upon a satisfactory basis in British Columbia. The Company referred to is one of the most important in the United States, and would not have decided upon taking such a step unless is was perfectly satisfied that the position of things fully justified it. The inducement offered by the Dominion Government in the shape of a bonus on every ton of ore smelted in the Province, has undoubtedly had a beneficial influence in the matter. It is also a proof that the Company is satisfied both as to the supply of dry ores, obtainable in the district, being ample for its requirements, and also that it can find a market for the lead produced at prices that will be remunerative.

The smelter at Pilot Bay appears to be overcoming the difficulty which was first encountered of getting a sufficient supply of dry ores and, therefore, that may be considered as an enterprise firmly established. With the third smelter which the Hall Mines Company has decided to erect at Nelson, principally for the treatment of the ore from the Silver King mine, there will be three smelting works in operation in West Kootenay, and we may, therefore, now consider that the smelting industry will, in a short time, be a most important factor in the development of the wealth of one of the most important mineral sections of this Province.—*Statistic News Advertiser.*

Mineral Shipments from Trail Creek, B.C.—From statistics furnished by the local Customs officials the following is the estimated amount and value of the shipments of gold, silver and copper ores shipped from the Trail Creek district for the fiscal year ending June 30th, 1895. Although for twelve months, yet almost the whole of the shipments have been made during the last five months:

Gold	20,510 ounces	$400,200.00
Silver	29,804 "	21,802.30
Copper	925,693 pounds	46,372.65
Total value		$468,374.95

A New Coal Calorimeter.—In a paper presented to the American Society of Mechanical Engineers at Detroit recently, Mr. R. C. Carpenter describes an instrument for determining the heating value of coals. In principle it is a large thermometer, the combustion taking place in the bulb and the heat being absorbed by the liquid in the bulb, the heat causing the liquid to rise in a glass tube extending upward outside. The fuel is placed in a dish in the bottom of the combustion chamber, and is fired by an electric current through a platinum wire, and oxygen is supplied through a tube. The discharge gases pass through a long coil of copper pipe.

The Down-Draught Furnace for Steam Boilers.—At the meeting of the American Society of Mechanical Engineers, Mr. W. H. Biyan, St. Louis, described the down-draught boiler furnace invented by M. C. Hawley, of St. Louis, which is said to have done more than any other mechanical device towards the solution of the smoke problem. In this furnace the fire burns downward, instead of upward, the coals being sustained upon grates which are water tubes connected with the water circulation of the boiler. The air enters the furnace above the fire, and passes down through it. Some of the coals drop down through the grate, and are burned upon a grate below with an upward draught, the gases from both the fires passing onward together to impart their heat to the boiler. It is said that 90 per cent. of the furnace work is usually done by the upper fire with the down draught.

Welding Nickel Steel.—H. P. McIntosh, the secretary of the Canadian Copper Company of Cleveland, has this to say regarding some trials the company has made recently in welding nickel steel: In each trial two pieces, each one inch square by six inches, were welded together with a lap weld, with the following results:—No. 1.—Samples containing nickel 2.05 per cent. and carbon 0.22 per cent. cut like soft steel, welded perfectly, with no sign of weld showing; bent twice at right angles at the weld when hot, weld did not open nor was any crack noted; bent at right angles when cold, failed to show any crack at weld. No. 2.—Samples containing nickel 3.25 per cent. and carbon 0.16 per cent. worked exactly like No. 1, same tests, no crack seen; welded perfectly. No. 3.—Samples containing nickel 3.40 per cent. and carbon 0.31 per cent. cut a trifle harder, also hammered like a harder steel, welded perfectly, bent hot and cold like No. 1, showed no crack, weld cannot be seen. No. 4.—Samples containing nickel 2.62 per cent. and carbon 0.19 per cent. worked exactly like Nos. 1 and 2, same tests did not show any weakness at weld. No. 5.—Samples containing nickel 3.20 per cent. and carbon 0.54 per cent. worked a little harder, but gave perfect, solid weld; no cracks on bending hot and cold. No. 6.—Samples containing nickel 3.10 per cent. and carbon 0.96 per cent. worked harder, *i.e.*, like a tool steel, welded perfectly, no cracks on bending hot and cold. No. 7.—Samples containing nickel 4.95 per cent. and carbon 0.51 per cent. worked like No. 5, not so hard as No. 6, perfect weld, no cracks on bending. In general, the percentage of nickel does not affect the welding power at all. The steel must be treated like any other steel, using more care with the higher carbon.

The Great Water Wheels at Niagara.—The three wheels now set and completed for the Niagara Falls Power Company were designed by Faesch and Piccard, of Geneva, Switzerland, and were built under contract with the I. P. Morris Company, of Philadelphia. They consist of two Fourneyron turbines, one being set inverted and vertically over the other, so as to neutralize weight on the step or bearing. Each of these twin wheels is, moreover, made three stories high or deep, and the speed gate consists of a cylindrical rim, moving up and down on the outside of each wheel. To further neutralize weight on the upper bearing of the shaft, the water from the supply tube is allowed to pass through the disc of the upper guide wheels, and to act vertically upward upon the disc of the upper turbine wheel. The disc of the lower guide wheel is, on the other hand, solid, and the weight of water upon it is supported by three inclined rods passing through it and the wheel casing. These wheels will discharge 430 cubic feet per second, and, acting under 136 ft. of fall from the surface of the upper water to the centre between the upper and lower wheels, will make 250 revolutions per minute; at 75 per cent. efficiency they will give 5,000-horse power. The turbine wheels are made of bronze, the rim and buckets forming a single casting. The shaft is a steel tube 38 in. diameter, except at points where it passes the journal bearings or guides, at which it is 11 in. in diameter and solid. A heavy flywheel was originally designed to be mounted on this shaft, to enable the governor the better to control the speed of the wheel, but has been replaced by the revolving field of the dynamo.—*Cassier's Magazine.*

Limitation of Explosives.—Mr. Frank Clowes, Professor of Chemistry in the University College, Nottingham, read, before a recent meeeting of the Institution of Mining Engineers, an interesting paper on "The limtiing explosive mixtures of various combustable gases with air," and gave as the conclusions of his experiments—1. When mixed with atmospheric air at ordinary atmospheric pressures different combustible gases show different limiting explosive proportions. 2. The range between the lower and upper explosive mixtures is least in the case of methane or fire-damp. The range is widest in the case of hydrogen, but carbonic oxide shows an almost equally wide range. The limits in the case of water gas are widely separated; with coal gas the range of explosibility is less. 3. The tendency to explode is greater when the mixture is fired from below than when it is fired from above. Hence the lower-limit mixture contains less gas, and the upper-limit contains more gas, when the mixture is fired below than when it is fired above. 4. Since the risk of explosion occurring when a gas is mixed in unknown proportion with air is diminished as the limits of explosibility approach one another, the gases which were employed in these experiments may be placed in the following order of increasing danger:—Marsh gas, ethylene, coal gas, water gas, carbonic oxide, hydrogen. 5. In every case the danger of an explosion resulting from a naked flame being brought into contact with a mixture of unknown composition is greatest when the flame is applied to the bottom of the mixture than when it is applied to the top.

This paper was followed by another from Mr. Clowes, on "The change of Composition Produced in Air by Flames and by Respiration." As the result of experiments, he stated that the proportion of oxygen left in the residual air corresponded to that contained in the artificially produced athmosphere which had previously been found to extinguish each flame. Further, that the composition of the extinctive atmospheres left by the common wick-fed flames was very similar, and closely corresponded with the composition of expired air. A coal-gas flame, however, was able to reduce the proportion of oxygen in the air to a considerably greater extent than ordinary, wick-fed flames; while the hydrogen flame diminished the oxygen in the air to about one-third the amount left by these flames, and to one-half that left by the coal-gas flame. The combustion of fire-damp (marsh gas) produced an effect on the composition of the air which was very similar to that of the wick-fed flames. The results obtained by Dr. Haldane on the respirability of atmospheres of various composition prove that the air in which the wick-fed flames or the flames of fire-damp had burnt until they became extinguished was respirable not only with safety, but even without inconvenience. This was also true of air which has been once breathed, and which extinguishes ordinary wick-fed flames. Dr. Haldane further maintains that no permanent injury to health would result from breathing such atomspheres for some time. It follows that the extinction of the flame of a candle or a safety-lamp in air did not prove such air to be unfit for respiration, and that accorded with the experience of many practical miners.

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20	15 00	40 to 72
25	22 50	72 to 120
35	30 00	120 to 220
45	45 00	220 to 300

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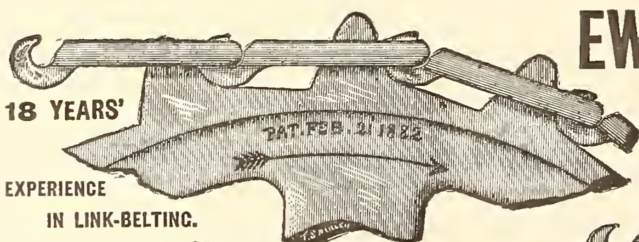

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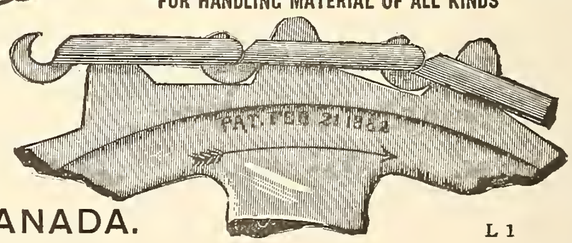

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—AND—

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GOLD AND SILVER.

Under the provisions of chap. 1, Acts of 1892, of Mines and Minerals, Licenses are issued for prospecting Gold and Silver for a term of twelve months. Mines of Gold and Silver are laid off in areas of 150 by 250 feet, any number of which up to one hundred can be included in one License, provided that the length of the block does not exceed twice its width. The cost is 50 cents per area. Leases of any number of areas are granted for a term of 40 years at $2.00 per area. These leases are forfeitable if not worked, but advantage can be taken of a recent Act by which on payment of 50 cents annually for each area contained in the lease it becomes non-forfeitable if the labor be not performed.

Licenses are issued to owners of quartz crushing mills who are required to pay Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at $19 an ounce, and on smelted gold valued at $18 an ounce.

Applications for Licenses or Leases are receivable at the office of the Commissioner of Public Works and Mines each week day from 10 a.m. to 4 p.m., except Saturday, when the hours are from 10 to 1. Licenses are issued in the order of application according to priority. If a person discovers Gold in any part of the Province, he may stake out the boundaries of the areas he desires to obtain, and this gives him one week and twenty-four hours for every 15 miles from Halifax in which to make application at the Department for his ground.

MINES OTHER THAN GOLD AND SILVER.

Licenses to search for eighteen months are issued, at a cost of thirty dollars, for minerals other than Gold and Silver, out of which areas can be selected for mining under lease. These leases are for four renewable terms of twenty years each. The cost for the first year is fifty dollars, and an annual rental of thirty dollars secures each lease from liability to forfeiture for non-working.

All rentals are refunded if afterwards the areas are worked and pay royalties. All titles, transfers, etc., of minerals are registered by the Mines Department for a nominal fee, and provision is made for lessees and licensees whereby they can acquire promptly either by arrangement with the owner or by arbitration all land required for their mining works.

The Government as a security for the payment of royalties, makes the royalties first lien on the plant and fixtures of the mine.

The unusually generous conditions under which the Government of Nova Scotia grants its minerals have introduced many outside capitalists, who have always stated that the Mining laws of the Province were the best they had had experience of.

The royalties on the remaining minerals are: Copper, four cents on every unit; Lead, two cents upon every unit; Iron, five cents on every ton; Tin and Precious Stones; five per cent.; Coal, 10 cents on every ton sold.

The Gold district of the Province extends along its entire Atlantic coast, and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the Counties of Cumberland, Colchester, Pictou and Antigonish, and at numerous points in the Island of Cape Breton. The ores of Iron, Copper, etc., are met at numerous points, and are being rapidly secured by miners and investors.

Copies of the Mining Law and any information can be had on application to

THE HON. C. E. CHURCH,

Commissioner Public Works and Mines,

HALIFAX. NOVA SCOTIA.

The Canadian Mining Review

Established 1882

Vol. XIV.—No. 9 | 1895—OTTAWA, SEPTEMBER—1895. | Vol. XIV.—No. 9.

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Mining lands may be taken up as surveyed locations or staked claims.

Locations range from 40 to 320 acres.

Claims range from 10 to 20 acres on vein or lode.

Locations may be acquired in fee or under leasehold.

Price of locations north of French River, $2 to $3 per acre, and south of it, $2 to $1.50, according to distance from railway.

Rent of locations first year 60c. to $1 per acre, and subsequent years 15c. to 25c. per acre.

Rent of claims, $1 per acre each year.

Claims must be worked continuously.

Royalty on ores specified in the Act, 2 per cent. of value at pit's mouth less cost of labor and explosives.

Royalty not charged until seven years from date of patent or lease, nor (as provided in s. 4 (3) of the Mines' Act, 1892), until fifteen years in the case of an original discovery of ore or mineral.

Original discoverer of ore or mineral on claim entitled to stake out a second claim.

Crown Lands sold under provisions of mining laws in force prior to 4th May, 1891, exempt from royalty.

Copies of the Mines Act, 1892, Amendment Act, 1894, may be had on application to

ARCHIBALD BLUE,
Director Bureau of Mines

TORONTO, May 25th, 1894.

CONDITIONS
OF
Obtaining Government Drill to Explore Mines or Mineral Lands.

Owners or lessees of mines or mineral lands in Ontario may procure the use of a Government Diamond Drill, subject to the provisions of the Rules and Regulations relating thereto, upon giving a bond for payment to the Treasurer of the Province, of costs and charges for (1) freight to location, (2) working expenses of drill, including labor, fuel and water, (3) loss or breakage of bits, core lifters and core shells, (4) wear or loss of diamonds, (5) other repairs of breakages and wear and tear of machinery at a rate per month to be estimated, and (6) an additional charge of $50 per month after the mine or land has been shown, through use of the drill, to be a valuable mineral property.

Of the aggregate of costs and charges above enumerated, excepting the sixth item, forty per cent. will be borne by the Bureau of Mines in 1894, thirty-five per cent. in 1895, thirty per cent. in 1896, and twenty-five per cent. in each year thereafter until the end of 1900. All accounts payable monthly.

For Rules and Regulations *in extenso* governing the use by companies and mine owners of Diamond Drills, or other information referring to their employment, application may be made to ARCHIBALD BLUE, Director of the Bureau of Mines, Toronto.

A. S. HARDY,
Commissioner of Crown Lands.

Toronto, October 17, 1894.

John E. Hardman, S.B.

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The Canadian Mining Review

Established 1882

Official Organ of The Mining Society of Nova Scotia; The General Mining Association of the Province of Quebec; The Asbestos Club; and the Representative Exponent of the Mineral Industries of Canada.

B. T. A. BELL, Editor. Published Monthly. OFFICES: Slater Building, Ottawa.

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British Columbia Mining.

This month the REVIEW sends to British Columbia a special correspondent to write up the important mineral developments now taking place in the Cariboo, Trail Creek, Slocan and other mining districts of that province. Our correspondent is an eminent English mining engineer, with a wide experience in the production of the precious metals and his contributions to these pages, copiously illustrated, will doubtless be of value to our readers interested in British Columbia mining investments.

Canadian Companies

Kootenay Consolidated Mining Co., Ltd., has been registered with an authorized capital of $500,000 to purchase and operate mines in the Province of British Columbia. The directors are :—George D. Scott, Vancouver ; A. J. Scott, Vancouver, and W. J. McGuigan, Vancouver. Head office : Vancouver.

St. Elmo Gold Mining Co., Ltd., has been registered under the Foreign Companies Act, B.C., with headquarters at Spokane, Wash., and an authorized capital of $1,000,000.

Iron Horse Mining and Milling Co., Ltd.—Registered 10th August, 1895, with an authorized capital of $1,000,000, and headquarters at Spokane, Wash. To carry on mining in the Province of British Columbia.

Western Prospecting and Promoting Co., Ltd., has been incorporated at Victoria, B.C., with an authorized capital of $100,000 and headquarters at Vancouver, B.C. Directors: Richard E. Leonard, T. H. Tracey, George Geary, Alfred A. Smith, and Edward C. Taylor.

The Nanaimo Alberni Gold Mining Co., Ltd., has been incorporated under the laws of British Columbia, to acquire certain mineral claims held by William Leslie Jones and Alfred R. Hyland, respectively, situated at China Creek, in the district of Alberni, and to pay for the same either in cash or fully paid up stock of the company. The authorized capital is $300,000. Directors: Andrew Haslam, *President;* W. E. Morris, *Secretary;* and Wm. K. Leigton, *Treasurer.* Head office at Nanaimo, B.C.

Kootenai Mining and Milling Co., Ltd.—Registered 10th August, 1895, with headquarters at Spokane, Wash., and an authorized capital of $1,000,000. To carry on mining and milling in British Columbia.

Spokane Ore Co., Ltd., has been registered under the Foreign Companies Act, with an authorized capital of $5,000,000, and head office at Spokane, Wash., to carry on mining and milling in British Columbia.

Columbia Hydraulic Mining Co., Ltd.—Registered at Victoria, B.C., 19th July. Authorized capital, $100,000. Head office: Chicago, Ill.

British American Mining Co., Ltd.—Registered 1st August. Authorized capital, $500,000. Head office: Butte, Montana.

Phœnix Gold Mining Co., Ltd.—Incorporated in the United States, 12th August, 1895. Registered at Victoria, B.C., 3rd September, 1895. Authorized capital, $500,000. Incorporators: J. W. Wetherop, David Herman, J. F. Reddy, Jas. Cronan, J. H. Bench, J. K. Riordan, D. C. Newman. Head office: Spokane, Wash.

High Ore Gold Mining and Smelting Co.—Incorporated at Spokane, 14th June, 1895; registered, B.C., 3rd September, 1885. Authorized capital, $500,000. Directors: Cyrus Happy, *President;* D. M. McLeod, *Secretary;* Robert Russell, J. H. Griffith, H. L. Rogers, W. G. Estess, J. H. Kitcham, George H. Hughes, J. D. Findlay, A. B. Railton. Head office: Spokane, Wash.

Van Winkle Consolidated Hydraulic Mining Co.—A meeting of the shareholders is to be held at the company's office, Vancouver, B.C., this month, to authorize the company to dispose of the whole of their assets to another company for the purpose of working their mining claims conjointly with others.

Centre Star Mining and Smelting Co., Ltd,—Registered 16th July, 1895, at Victoria, B.C., under the Foreign Companies Act, to carry on mining in the Trail Creek division, West Kootenay mining district, and to develop the Centre Star mineral claims, etc. Authorized capital, $500,000. Head office: Butte, Montana.

Horsefly Hydraulic Mining Co., Ltd.—Advices up to 23rd ulto. report that everything is going on satisfactorily and there is nothing of importance to mention.

Cariboo Hydraulic Mining Co., Ltd.—Recent advices state that the supply ditch was completed on 19th ulto., and the supply of water from Polley and Bootjack lakes made available for the company's purposes. The ditch was found to work satisfactorily, while the quantity of water it will deliver will be ample for the company's requirements. Unless some unforeseen accident should occur, there should be nothing to prevent the company from running continuously to the close of the season. With average weather active hydraulic operations should be possible until the middle of October, and, perhaps, even for a week or two beyond that date.

War Eagle Gold Mining Co.—Last report from this claim says :—The mine has resumed shipments after a suspension of several days, chiefly caused by the fact that the power for the two drills at work in the mine being obtained from the Le Roi compressor plant, the alterations being made in the machinery at the latter mine prevented power being given to the War Eagle. This work, however, being now completed, operations at the War Eagle are resumed. Connection has now been made between the upper tunnel and the west shaft and stoping has again been started. As soon as the 20-drill air compressor plant, which is now on the way to the mine, is on the ground, the new tunnel will be started and pushed forward and the immense body of ore between the first and second levels opened up and mined.

Hall Mines, Limited.—This company has let a contract to the well known firm of Fraser & Chalmers, of Chicago, for a smelting plant of the capacity of 100 tons of ore per day. The contract provides that the smelter is to be completed by December 15th next. The company is pushing on with the aerial tramway between the Silver King mine and Nelson, and such progress has already been made on this that it will very shortly be ready for operation. Large ore bins are being constructed at Nelson, and the company will soon have every facility for economically and expeditiously getting its ore down to the shipping point or smelter.

Horsefly Gold Mining Co., Ltd.—This company is making preparations for extensive hydraulicing on its property next season. The litigation which has hampered its operations for the last three years has been brought to a conclusion and there appears no reason to anticipate further delays in the profitable development of the rich ground which the company has in its leases of what is known as the old "Harper claim." It expects to be able to handle 2,000 yards a day with the machinery which it intends to put in.

Lillooet, Fraser River and Cariboo Gold Fields, Ltd.—A special meeting was held in London, England, on the 18th instant, when resolutions were proposed increasing the capital from £50,000 to £300,000 ; raising the board of directors from five to nine members, and appointing as additional directors the Hon. Forbes George Vernon, M. Henri Rosenheim, Baron de Machiels, and Dr. Jules Goldschmidt, the last three being resident in Paris; and appointing Mr. F. S. Barnard, M.P., as managing director. In reference to this meeting and the proposals to be submitted, the directors have issued a circular to the shareholders from which we take the following :-

The directors having, in pursuance of the powers vested in them for carrying out the objects of the company, secured throughout the Province of British Columbia many mines, mining rights and claims, and having selected from them six properties as the most promising, which have, by extensive works, shafts, tunnels, etc., and repeated and elaborate assays, been proved to contain gold in large quantities and to be of great value, they are of opinion that the time has arrived for the company to alter its operations from those of a Prospecting and Exploration Syndicate to those of a large Development Company.

For the purpose of doing this it will be necessary to largely increase the capital and strengthen the executive of the Company.

With a view to securing expeditiously a portion, viz., £200,000, of the additional capital which it is proposed to create, the Company's brokers in London and Paris have organized a syndicate, in which they themselves and the directors have taken a considerable share, and which will be managed by the Company's Paris brokers (the senior member of whose firm is proposed as one of the additional directors), to guarantee the subscription of half the new issue, viz., £100,000, if it should not be subscribed forthwith by the present shareholders or warrant-holders, on condition of the syndicate having the option for one year to take at par the remainder of the new issue.

You will observe that it is not proposed to issue at present £50,000 of the new capital. This the directors deem it wise to retain in the Company's treasury, for the purpose, if necessary, of issuing the same as fully-paid shares in payment of any further properties it may be thought advisable to acquire."

The Canadian Exploration Syndicate, Ltd., was registered in London, Eng., on the 20th ulto., with a capital of £2,000, to explore mines and lands in Canada and elsewhere.

Byron N. White Co., Ltd.—Of this company the *Northwest Mining Review*, Spokane, Wash., says: "It is always made public when a dividend is paid by a company whose stock is on the market and it is a matter greatly to be regretted that all dividends paid by any incorporated mining company is not made public to those who are constitutional bears on mining may have their eyes opened. Large dividends are frequently paid by so-called private mining corporations of which nothing is heard, and this has been the case with the famous Slocan Star mine in the Slocan country. The mine is in an advanced stage of development, having no less than four levels run to tap the vein, drifts extended both ways at right angles to the tunnels and upraises made are all in ore. Estimates made by disinterested parties vary as to the amount of ore in sight, but the lowest estimate made by such parties is that there are over $3,000,000 worth of ore in sight. The owners make no estimate themselves, but are quite well satisfied with the showing, as they should be. The mine has paid for itself, and all development, a large sinking fund is set aside for machinery, and on August 1st a 10 per cent. or $50,000 dividend was declared. A contract has heen let to the Porter Brothers for a flume and tramway, and Mr. B. N. White has gone east to open bids for a 100-ton concentrating plant to be built this fall. The K. & S. Railroad has built as near to the workings of the mine as possible and the ore will be trammed to ore-bins alongside the track. Nor will they be at the mercy of one road, as the N. & S. Railroad will also have entered the field by the time the concentrator is completed. The dividends will be both large and frequent as soon as the concentrator is running, for then, for the first time, will the mine be operated at full capacity. The clean or shipping ore will also be taken out and shipped.

CORRESPONDENCE

Gold Mining in New Brunswick.

The Editor:

At a point in Northumberland County, New Brunswick, not far from the junction of the three counties, Restigousche, Victoria and Northumberland, a crew of men are busily engaged in prospecting for gold, under, it is thought, promising auspices. The Northern New Brunswick Mining Company is the name of the concern which has the working of this mine and its officers are:— Directors, Sol. Perley; John Graham; S. T. Baker; D. W. Johnson; F. H. J. Dibblee: Sol. Perley, President; F. H. J. Dibblee, Vice President; J. C. Hartley, Secretary; John Graham, Treasurer.

The mining lands are situated on the hanks of the Serpentine stream, a branch of the Tobique river. The Tobique empties into the St. John river about fifty miles above Woodstock, and near Andover, the Capital of Victoria County. Along the banks of the Tobique are very fine farming lands, scarcely yet begun to be developed. Between fifty and sixty miles up the Tobque the river branches off into four directions and the appropriate name of "The Forks" is given to this point of separation. One of these branches which runs into Northumberland County is the Serpentine, and on this stream six miles from its mouth is the mining limit. Last autumn the Company bought a stamp mill from Fraser and Chalmers, Chicago, at a cost of $1,000. It has a crushing capacity of over three tons a day and is equal to five horse power. It was taken up the "Forks" and there remained all winter. On the 27th day of May a party of men, under the direction of Mr. Sol. Perley, left Woodstock for the mining lands. The journey up to the forks from the mouth of the Tobique had to be made by waggon, there being a railway (so-called) but useless for practical purposes. Moving the heavy stamp mill was no child's play. It was first loaded on a flat boat 44x9. For part of the way along the river this worked very well, but the time soon came when the boat struck the bottom of the narrow stream. The only chance left was to unload the mill and carry it up the stream by sections. It was a very happy day for the miners when they found themselves safe and sound with the stamp mill, on the banks of the Serpentine.

The mill was started on the 4th of July and works to perfection.

The bit of land which the Company controls is about ten miles square. It is described as being covered with a mossy growth. The mining party have erected fine buildings, the mill house being 14 x 36. Water to run the mill with is brought in by pipes about forty rods from the foot of the immense hill on the opposite side of the stream. Ten veins have been tested and the result is said to be satisfactory. These veins lie within a distance of seventy-five feet and are along the bank of the river. It s not claimed by the Company that the gold is of a very high order, but as it lies on the surface and is easily mined, they are confident it can be mined on a paying basis. The President has just been in Woodstock after a two months stay at the mine. He is at the time of writing, in St. John on a business trip.

Much interest is taken in the mine here, and there is a general hope and expectation that something may come of it. The miners themselves are so confident that they have already named the town and set it out in "lots."

T. C. L. K.

St. John, N.B., 1st August, 1895.

Novel use of Mica.—The uses of mica are manifold. One of its latest developments is distinctly novel. An ingenious Australian has invented and introduced a mica cartridge for sporting and military guns. The filling inside the cartridge is visible and a further advantage is that instead of the usual wad of felt a mica wad is used. This substance, being a non-conductor unaffected by acids or fumes, acts as a lubricant. Where smokeless powders, such as cordite or other nitro-glycerine compounds are used, mica has a distinct advantage over every other material used in cartridge manufacture. Being transparent, any chemical change in the explosive can be at once detected. The peculiar property it has of withstanding intense heat is here utilized, the breech and barrel being kept constantly cool. The fouling of the rifle is also avoided, the wad actually cleaning the barrel.

NOVA SCOTIA NOTES.

Our windy Halifax contemporary, the *Colliery Guardian, Critic, &c., &c.*, comes out with the startling intelligence that the South Kensington School of Mines, so far as coal mining is concerned, is a gigantic humbug. Whether the School of Mines will survive this blow or not remains to be seen, but we would like to enlighten the *Critic* on a few points. In the first place there is no such institution as the South Kensington School of Mines, the title, until quite recently, being the Royal School of Mines, and it has now assumed the new-fangled title of the Royal College of Science, with which is associated the Royal School of Mines. The very fact that the controlling board have attempted to introduce the Royal College of Science by the prestege of the Royal School of Mines, is sufficient compliment to that old-time institution which has turned out some of the best men of the day in both coal and metalliferous mining. Secondly, that it was and is possihle to obtain the Associateship of the school in either geology, metallurgy or mining, consequently a man who takes his associateship in metallurgy or geology, may, through force of circumstances, turn his attention to mining and is naturally not as sound as a man who has taken his associateship in mining.

Thirdly, during the four months' summer vacation the students are supposed to put in a considerable part of the time in either some mine or metallurgical establishment, or in field work; some of them do not always avail themselves of the introductions they can obtain from the professor for this purpose and are naturally not so good as those who do.

A school of mines at the best can only give a sound foundation for after work and it must rest with the student whether he makes proper use of this in after life. It is manifestly unfair because a few duffers can be found who have graduated from a school or university to condemn the whole institution.

An attempt is being made to open the Foord pit, Pictou Co. A 15 inch brick wall is being huilt to shut off the part supposed to be smouldering, and sand will be poured down behind to protect it. The air in the pit is reported to contain little or no gas.

A new find of gold has been made on and near the Dufferin mine, east of the present workings. T. R. Gue and others have taken up 374 areas.

Several very good returns of gold have been made at the Mines Office for the month of August. Fifteen Mile Stream heads the list with 409 oz., this increased return, we are informed, is due purely to a change in the management, the quartz gives about the same average amount of gold and the same number of men have been employed as heretofore.

A new find of gold has been made on the Dartmouth and Cow Bay road and 149 areas have been taken up.

Mr. George Stuart called on us recently. He is well satisfied with the progress made on the Plough-head property. He is also prospecting on his property in Wine Harbor with a view to cutting the Romkey, Twin and Eureka leads. He reports the surface as being very heavy.

The Golden Lode continues its splendid record. Mr. A. A. Hayward was in town with a 209 oz. brick and a 5% dividend has been declared for the month.

Mr. J. C. McDonald has resigned the management of the Woodstock mine at Forrest Hill, and Mr. W. J. McIntosh, Mr. J. E. Hardman's late foreman, assumes control. The property is looking well and we expect to hear good accounts of it.

Mr. J. A. Fraser's new plant, erected on the old Chicago property, is in full operation. Mr. Fraser is well pleased with the results of his development work.

Mr. Fraser has taken an option (with the right to develop) of the Mason-Hudson property, adjoining the Woodstock and Forest Hill properties. Mr. Fraser has a high opinion of both the richness and extent of this locality.

Messrs. B. M. Davidson *et al.* have just completed the erection of a modern 10-stamp mill on their property in Wine Harbor. They report their Romkey and Twin leads at depths of from 25 to 120 feet, looking exceedingly well.

The Arthur-Partridge mine, known as the Springhill mine, Goldenville, is reported to have produced 200 oz. last month. This is a very handsome return for the small outlay which has been made on this property.

It is a particularly pleasing feature in the returns to see that sterling district of Goldenville once more on the producing list. Goldenville has been the best district in Nova Scotia, and we think there is every reason to believe it will be again before very long.

Mr. Whitney and several of the directors of the Dominion Coal Co. have paid a visit to their mines in Cape Breton, and are well pleased with their property and the progress made on it.

Mr. Miers, of New York, is making a thorough test of the Collins pulverizer, amalgamator and concentrator. Should his report be satisfactory, it is likely that the New York people for whom he is making the tests, will put up a custom plant with a bromination works attached.

Manager Hargreaves is taking a vacation trip to his old home in England. He is now there, and is expected to be away a month longer. Assistant Manager Matthews relieves him. Mr. Robert Archibald, formerly of Joggins, spent the last four months at Springhill and contemplates going to Scotland about October first.

At Joggins, work is fairly brisk, with an output of 350 tons daily. Most of this comes from No. 3 slope—only one level of No. 2 slope is now being worked. A strike which lasted a fortnight, took place in August, ended rather unfortunately for the men. After resisting for two weeks they accepted the terms originally offered them by the Company.

F. HILL, Mining Engineer, Port Arthur, Ont.

The coal trade of Cumberland County, during the summer months is confined to the Springhill and Joggins collieries. The demand has been about as usual, for these months when there is little coal burning weather. The barges built by the Springhill Company a couple of year sago, have been kept busy between Parrsboro and Bay of Fundy and New England ports. Transportation has been cheapened and the owners of barges have benefited in consequence or been enabled to push their sales into new territory in the face of keen competition.

St. John is the principal market for Cumberland coal. Competition, there, has been keener than ever owing to the determined effort made by the Dominion Coal Co. to obtain a foothold for Cape Breton coal in that market. Prices have been falling ever since the beginning of the season, and the war is still carried on with great vigor. Meanwhile St. John manufacturers, and others are enjoying the fun, and endeavoring to make long term contracts to provide against a possible agreement among the coal companies.

At Springhill very little new work is being carried on, with the exception of the rebuilding of No. 3 slope pithead buildings, destroyed by fire in February. Thus far only the trestle work in the immediate vicinity of the slope has been erected, and it is reported that the Company has abandoned the trestle connecting the two slopes. The engines at No. 3 slope which were badly damaged by the fire, have been thoroughly overhauled and repaired by Roob, of Amherst. A substantial foundation has also been put in, so that this slope should be in readiness for work within a couple of months if required. Nothing has yet been done towards rebuilding at No. 2 slope. Meanwhile only No. 1 slope is operated. The output is about 1600 to 1700 tons for a shift and a half. The pit works all day, and a half shift at night, which gives the men three-quarter time steadily. The outlook for the winter, with the return of better coal-burning weather and a stronger demand for domestic coal, is considered fairly good.

Mr. Henry McArthur has filled the position of Acting Manager since the resignation of Mr. Archibald in May.

The River Hebert Mine, the property of the Seaman estate, worked under lease by Mr. Wm. Hall, has resumed operations on a large scale. Mr. Hall has a contract for five thousand tons for the I. C. R. During the summer the slope was sunk 300 ft., level driven a considerable distance east and west, opening up a new part of the area where the coal is of better quality. The capacity of the mine has thus been increased to about fifty tons a day.

The smaller mines about Maccan and Chignecto, which have been idle since April, are again showing signs of life and activity. Their sales are confined to the immediate neighborhood of the pits. One of the pits formerly worked by Messrs. Wetherby and Ripley, is said to be lost through careless mining, followed by spontaneous combustion. Mr. James Baird, who understands the nature of that coal-field, and is a sound practical operator, has had greater success. The Smith pit at Maccan station is doing little or no work, and the coal seam continues unsatisfactory. Occasionally this mine is visited by some Americans who appear to have a scheme of some kind concealed about their person, which fails to materialize. Mr. Frank Burrows has charge of the property.

The examination for granting managers certificates, came off on the 25th, 26th and 27th, of this month, at Springhill.

Gold Mining in Nova Scotia.

By F. H. Mason, Halifax.*

Twenty-five years ago Prof. Henry Youle Hind read a paper before the Society of Arts on "Gold Mining in Nova Scotia," and the writer proposes to draw some comparisons between the costs and methods of mining then and at the present day. The writer cannot give a better description of the lodes than Prof. Hind, who has made a life-long study of them, who wrote as follows :—

The lodes of Nova Scotia may be grouped as follows :

I. Bedded Lodes—Consisting of beds of quartz interstratified with slates and quartzites of contemporaneous age with them, these are the most abundant, and from them a considerable proportion of the gold is obtained.

II. Intercalated Lodes—These almost always, as far as known, occur in slates, and are numerous in broad bands of slate from 10 to 70 feet in width. Where these lodes abound it would be profitable to crush both the slate and the quartz, for gold is not infrequently found in the slate. The best illustrations of the intercalated lodes occur in Sherbrook and Wine Harbour.

III. Gash Lodes, occurring where the strata has been locally squeezed out of place. Instances are known in various districts, the most important being at Renfrew.

IV. True Lodes or Veins, cutting the strata. Some of these are very rich, but those which have been worked proved very narrow. The irregularity of true lodes is well known, and the fact that hitherto this class has yielded comparatively inconsiderable results should not discourage operations, for true lodes frequently thin out to a mere film of quartz and increase to a thickness of several feet within a vertical distance of a few fathoms.

These lodes occur in the lower silurian formations.

Prof. Hind describes the Sherbrook gold district as follows :—

If a slightly undulating line be drawn on the course of S. 83 degs. W. (true) or N. 75 degs. W. magnetic north, from area 775, on the east side of the St. Mary's river, it will represent part of the axis of the Sherbrook anticlinal. On the north side of the axis the lode dips to the north at an angle of about 45 degs., except on approaching the axis, when they commence to curve. On the south side the dip varies from 80 degs. to vertical, except when making the curve. Proceeding south from the axis, the lodes become more persistently vertical, until they acquire a slight northerly dip, thus showing that the form of the anticlinal is that of a slight overturn to the south, as represented in the sections. On making the curve some of the lodes sweep gradually round, with a dip varying from 80 degs. south to 60 degs. south-west, 35 degs. south-west by west 26 degs. W., then gradually increasing until they acquire the normal dip on the north side of the anticlinal of 45 degs. north. The strata and contemporaneous lodes at Sherbrook may be described as beds of slate and quartzite with thin sheets of auriferous quartz folded in an overturn anticlinal form, and subsequently tilted to the east by a cross anticlinal. The denuded crest of the intersections of the anticlinals has exposed the sheets of quartz in the form of long semi-ellipses, whose bases rest upon Cambrian gneiss, from which the silurian quartzites and slates have been removed by denudation. Numerous dislocations, having generally a north and south course occur in Sherbrook. These appear to have taken place during the north and south folding. Some of them are represented in the plans and in the sections.

Having given a description of a typical gold district, and one from which over 2,000,000 dollars worth of gold has been extracted, the writer will now turn to the methods of mining.

During the 25 years which has elapsed since Prof. Hind read his paper, the mining of gold in Nova Scotia has not progressed by the leaps and bounds which he had hoped to see. The principal improvements have been in the stamp-battery, the fast drop (90 to 100 per minute), taking the place of the slow drop of about 40 per minute, heavier stamps have been introduced and the construction of the mortar improved. Silver-plated copper plates are taking the place of copper plates, and the length of them considerably increased, and mercury traps have been generally introduced. Some few mines have put in concentrating machinery, but in the majority of cases the concentrates are allowed to flow away with the tailings, and enormous quantities of gold are being lost yearly through this neglect. This neglect is the more astonishing because in the majority of cases, the owners and managers know the value of the tailings which are being lost. The writer has in several instances made assays of concentrates which have run over 10 ozs. of gold per ton of concentrates, while the concentrates vary from 1½ to 10 per cent. of the total amount of ore treated. It is unusual for the writer to receive samples of concentrates which run under ½ ounce, although in some few cases they will run only 3 or 4 dwts. per ton. He has proved by experiments in his laboratory that the concentrates are capable of being economically treated by roasting and chlorination or bromination, and in the majority of cases by cyanide of potassium.

The concentrates from most of the mines are mainly composed of arsenical iron pyrites, those from the Montague and Uniacke mines are rich in copper pyrites, and also contain galena and blende in considerable proportions.

No scientific attempt has ever been made to treat these concentrates. A chlorination works was started at Waverley, the writer's experience being that the concentrates at Waverley are the poorest of any district in the province. The writer has been unable to obtain any reliable record, but has been told that large quantities of salt were used in the roasting, and the gold was lost in that process. Anyhow, it resulted in failure and was abandoned. An attempt to treat the tailings by cyanide of potassium was tried at Brookfield by people without experience of the process, and also resulted in failure. At the present time a chlorination works is being erected near Chester, a district where the concentrates are rich, and the writer hopes that the attempt may prove successful.

Professor Hind states:—"From careful assays of numerous parcels of tailings as they came from the mill and selected indiscriminately, the average quantity of gold contained was found to exceed 4 dwts. per ton." The writer's experience of samples of tailings sent to his laboratory gives an average in excess of that amount; but such an average would be unfair, because it contains several assays considerably in excess, and in some cases containing considerable quantities of auriferous mercury; it also includes assays of tailings, the ore of which never contained any appreciable amount of gold. These two factors make it extremely difficult to strike a fair average.

Prof. Hind gives as an instance of the way mines were worked 20 years ago the workings on the Tudor lode at Waverley. "The number of shafts by different companies on these lodes within a mean distance of 2,000 feet is 54, having a mean depth of 200 feet. This is equivalent to a shaft to every superficial area of 47 feet." Mr. John E. Hardman is now working this property for the Tudor Gold-Mining Company, by a series of levels and cross-cuts from a main shaft, and the writer is indebted to him for the following particulars of working expenses:—"The property has been worked for three consecutive years; the yearly average yield has been from 4 to 5½ dwts. per ton; the average width of the quartz vein has been and is 12 inches. The cost of mining the quartz per ton has varied from $1.25 upwards. The average cost per ton for mining, milling, and incidental expenses for last year was $3.20; this is from a depth exceeding 225 feet, and as deep as 400 feet. The costs include pumping, hoisting and all milling work. The milling cost and incidentals include salaries and office expenses, but excluding development and exploitation."

Many mines in Nova Scotia to-day are unfortunately not worked with the same degree of economy, and the writer regrets that the Tudor mine is an exceptional case, but it shows what can be done with a proper scientific knowledge of methods of mining.

The gold-miners of Nova Scotia have latterly been turning their attention to the large intercalated belts of lower-grade ore, and in this lies the future of gold-mining in this province.

As an instance the writer may quote the Richardson mine in the Stormont district, the lode has a minimum width of 6 feet, and a maximum width of 17 feet, with an average width of about 11 feet. Its yield runs from 4 to 8 dwts., with an average yield in excess of 5 dwts. of free-milling gold, the concentrates are totally disregarded, as at many other mines. This lode has been milled and mined for $2.27 per ton, including cost of pumping, management and office expenses, no allowance being made for wear and tear of machinery.

The majority of paying mines to-day are old workings which the old miners (most of whom were brought up as "tinkers, tailors, soldiers, sailors, apothecaries, or ploughboys") through lack of knowledge considered exhausted.

A typical instance may be quoted in the Hardman and Taylor property at Oldham.

An English company sank £16,000 in this property without returning any dividends. Twelve years ago Mr. Hardman assumed the management, and has taken from it, without expending any large amount of capital, over $500,000 worth of gold, while in some years the profits exceeded $40,000. Through Mr. Hardman's kindness the writer is able to give the following particulars :—

The Dunbrack vein has been the chief producing vein during the past ten years, over $400,000 having been obtained during that time from 7,600 tons of quartz. Several phenomenal yields have been recorded from this vein, such as in August, 1885, when 125 ozs. were returned from 2·40 tons, and in 1890 when 37 tons yielded 1,037 ozs., and in the same year 12 tons yielded 530 ozs. In 1891, 48 tons yielded 757½ ozs., and in the same year 88½ tons gave 1,084 ozs. In August, of 1893, 2 tons gave 250 ozs., or at the rate of 125 ozs. per ton. This year was the largest in the history of the district, the gross yield being 62,000 dollars. The Dunbrack vein has been opened by five shafts or inclines, varying from 157 to 483 feet in depth, and by levels at 150, 250, 300 and 450 feet; from the 450 level a winze was sunk 124 feet, making the greatest depth on the incline 574 feet, equivalent to about 407 feet vertical depth.

The workings are intersected by several small slides or faults, from a few inches to 6 or 7 feet in width, and are cut by two main dislocations, one of about 112 feet, which has been cut through in each level. The other large fault is supposed to be about 125 feet in extent, but no workings have as yet been carried beyond that fault.

The concentrates from this mine have been collected, and average from 65 to 70 dollars per ton.

Other instances of old mines being successfully reopened may be cited, such as the

*Paper read before the Fed. Inst. of Mining Engineers.

Antigonish Company's mine at Country Harbour, the Pictou Development Company's property at Renfrew, and the Golden Lode Mining Company's mine at Uniacke. Mr. A. A. Hayward has given the writer the following of the latter mine :—

During the last three years 200,000 dollars worth of gold has been extracted, the average yield being over 10 ozs. per ton, the vein is eight inches wide, and dips 32 degs. The maximum depth we have reached is a little over 500 feet, on the incline where the quartz is as good as ever. The capital of the company is 30,000 dollars, and dividends are being paid at the rate of 5 per cent. per month or 60 per cent. per year.

Amongst other improvements in the methods of mining is the use of machine drills, worked at pressures of from 60 to 100 pounds per square inch. A low grade dynamite (about 40 per cent. of nitro-glycerine) has almost universally superseded blasting-powder; no attempts have been made to use the higher grades of dynamite, gelatine-dynamite or blasting-gelatine. Dynamite has been considerably handicapped, as there is a heavy provincial import duty on it, and miners are unable to get it from the upper provinces, where it is manufactured, on account of the Government prohibiting its transit over the Intercolonial railway. However, through an agitation last year amongst mine-owners the local manufacturers have considerably reduced their prices, and a 40 per cent. dynamite can now be obtained at 16 cents per pound.

Perhaps one of the most notable features in the gold-mines of Nova Scotia is the lack of tramways from the pit-heads to the stamp-mill, the ore in many cases being hauled long distances by carts; this is due to the want of sufficient initial capital. Indeed, the want of capital is seen right through the gold-fields; it prevents the proper exploiting and development of the mines, and consequently when a difficulty is met with, such as a fault cutting off the vein, a good mine is often closed. The mines are not opened sufficiently, nearly all the profits going to dividend account, instead of some being reserved for development.

In attempting to interest capital in Nova Scotian gold mines, one is often met with the statement, "The veins in Nova Scotia are narrow, and the quartz is expensive to extract." The writer wishes to distinctly place on record that the first part of this statement is only partly true, and that the latter part is wholly untrue. Anyone starting mining operations in Nova Scotia may have the choice of narrow rich veins, varying from ½ inch to 18 inches in thickness, and carrying sometimes over 100 ounces per ton, or they may content themselves by working the big low-grade belts, from 10 to 70 feet wide, carrying from 2 to 8 dwts. of free-milling gold, and often as much as 5 dwts. in arsenical iron pyrites besides. Such belts occur in the Goldenville and Wine Harbour districts, and offer legitimate investment for capital. The second part of the statement is best refuted by Mr. Hardman's experience in working a 12 inches vein for 1·25 dollars per ton at the Waverley mine.

Labor in Nova Scotia is cheap, good miners commanding from 1·25 dollars to 1·75 dollars per day, laborers from 1 dollar to 1·25 dollars, and skilled mechanics from 1·75 dollars to 2·50 dollars per day. Coal may be obtained from 2·50 dollars to 3 dollars per ton at the pit-head, and wood can generally be had for 2 dollars per cord at the mine, stores explosives etc. etc., are also moderate. Nearly all classes of mining and milling machinery are made in the province, and are equal to anything that can be imported, and mining machinery not made in the province may be imported free of duty. Most of the gold mines are within 12 days from London and four days from New York, while many may be reached in two days less. Many of the mines have valuable water privileges. The winters, though long and severe, never interfere with mining operations, other than surface prospecting. The climate is healthy, and sport with both gun and rod is good.

The writer is satisfied that the gold mines of Nova Scotia offer a legitimate source of investment for capital, and with proper and economical management, remunerative returns may be looked for. Prof. Hind gave nine reasons why failure and collapse in place of continued prosperity have characterized some mining properties in Nova Scotia, and they are as true to-day as they were twenty-five years ago; they were :—

1. The absorption of all returns to pay large dividends.
2. The small size of some of the properties.
3. Insufficient working capital at the outset.
4. A uniform neglect in preserving records and plans in detail of work.
5. Inadequate machinery and appliances to save gold.
6. The want of labor-saving machinery.
7. Ignorance respecting mining operations, the gold streak, or "chimneys," or "pipes," or zone of auriferous quartz.
8. General neglect of the contract and tribute work.
9. And as a necessary result of the foregoing the frequent incompetency of some so-called managers.

As a typical instance of the way some mines are mismanaged, on a visit to one mine, which has since collapsed, the writer found six pumps in one shaft and the mine full of water, while a neighboring mine was being kept free with one pump.

The following table gives the returns from the different gold-mining districts for the year ending September 30th, 1894 :—

District.	No. of Mines.	Day's Labor.	No. of Mills.	Tons Crushed.	Yield of Gold per Ton.		Total Yield of Gold.		
					Dwts.	grs.	Ozs.	dwts.	grs.
Tangiers and Mooseland....	2	5,118	2	1,469	7	6	464	7	0
Caribou and Moose River...	4	21,657	3	9,727	5	17	2,779	16	17
Renfrew..........	1	5,020	1	757	15	14	590	0	0
Sherbrook..............	3	8,414	2	708	17	0	552	16	12
Fifteen-Mile Stream........	1	8,354	1	1,171	9	9	552	0	0
Uniacke.............. ..	3	10,797	2	1,544	18	1	1,394	8	1
Waverley..............	1	19,397	1	9,310	3	23	1,860	1	0
Whiteburn..............	1	4,846	1	555	12	3	336	8	0
Malaga..............	2	3,649	2	1,688	12	13	1,060	11	0
Lake Catcha..............	2	12,522	3	2,387	14	8	1,715	6	0
Stormont..............	5	16,768	6	6,628	5	23	1,980	4	18
Salmon River..............	1	5,496	1	1,467	3	16	271	5	0
Oldham..............	2	3,623	2	981	11	3	546	17	16
Unproclaimed districts......	5	13,479	6	939	18	15	876	5	12

It would be impossible to close a paper on the gold-mining of Nova Scotia without a reference to the Government Department of Mines. More than half the revenue of the country is derived from its mines, and yet there is much the country might do for the miner which it leaves undone. (1) There are no plans kept of the workings, consequently when a mine is shut down the plans are often lost, and if at any time anyone desires to reopen it, the task is rendered difficult and dangerous, all the information obtainable often being what can be obtained from the miners. (2) In what is known locally as the Blue Book (which is a yearly record of the mining industry) there is a vast amount of room for improvement. The Blue Book of 1894 is infinitely inferior to that of 1870; it contains many inaccuracies, and instead of being a means of interesting capitalists in the mines of the country, it is calculated to have exactly the reverse effect. (3) Proper surveys and maps should be at once made of all the mining districts, distinctly marking existing and old workings; these would meet with a ready sale amongst mine owners and mining engineers.

The Government has lately given a grant to the Mining Society of Nova Scotia, which institution is doing much to promote the mining industry.

As a rule, if anything is properly laid before the Government, they are willing to move in the matter, and many of these omissions are blameable to the mine-owners themselves for not bringing the matter properly to the notice of the Government.

NEW BRUNSWICK NOTES.

Since writing you last, no very decided change in regard to mineral matters in this province has taken place. Here and there you hear of some anticipated sale or development of a mining property, but nothing really tangible has as yet been shown. What the next few weeks may bring forth in this respect is hard to say.

Within the past few months some areas have been worked on in Albert Co., near the Goose Creek locality. A syndicate of Moncton gentlemen, and a Mr. Robt. Dryden, reported to be a practical Californian miner, have been opening up some quartz leads, assays of which, it is said, have shown tests of gold, silver and copper. There is some doubt as to its being a genuine gold-bearing and yielding lead, but the indications and appearances of copper are very good. In the meantime the promoters have taken out letters patent for incorporation with a fairly large capital and headquarters at Moncton, N.B. The unfortunate experiences of some of the Monctonites in the Memramcook Gold Mine is not calculated to cause any very great rush for stock in this venture, I predict.

Work of what might be called an initiative or inquiring character has been quietly prosecuted with a view to placing the salt works near Sussex in a first-class state of production, with suitable plant and machinery of most approved character. It is to be hoped the efforts may be finally successfully.

The promoters of the Gold Prospecting Company of Woodstock have been pushing forward their operations quietly yet energetically. The exact location of the company's property is in Northumberland County, near the borders of Victoria, on what is known as the Serpentine. With much hard work and at considerable cost they placed their 5-stamp mill at the point named, and have since been crushing and testing the rock from various leads on their areas. Some of these have been very satisfactory and show such good evidences of the yield of gold that the owners and promoters have been greatly encouraged. The company covers and controls mining interests in this locality embracing something like 10 miles in extent. There are about five buildings on the claims, including test mill, 14 x 16 ft. While every person in the province will be glad to know of the pluck and energy of these gentlemen and should be willing to give them all possible credit, and should not object to the Government treating them generously as to mining rights, etc., will it not seem a little too much of a good thing and somewhat after the dog-in-the-manger policy, to know they have absolute control over 10 square miles or = 6,400 acres of territory? Where is the inducement for other prospectors and capitalists if the impression gets abroad that these gentlemen have it all?

It was reported in July that immediate work of boring or prospecting for coal would take place on the Shives property at Dunsinane on the I. C. Ry. between Moncton and Sussex, but as yet no decided move in this direction has been made.

The gypsum property reported sold to New York capitalists some months ago still remains on the owners' or promoters' hands. A Mr. Sellock, who poses as the representative of New York capitalists, has been back and forth several times, but as yet no signs of his capitalists being ready to pay over their money. Whether it is that they doubt the genuine qualities of the properties they have made overtures on, or simply are playing a waiting game, hoping to eventually buy them cheaper, is a conundrum to be solved. At any rate the faith in the great New York capitalists who were reported in Moncton and vicinity has been seriously shaken of late.

The sale of a block of coal land in the Grand Lake coal fields recently is reported. The area was formerly owned and worked by Walter MacFarlane, of or near Fredericton. The property was sold through efforts of Dr. J. E. March, of St. John, and F. W. Wedderburn, Esq., of Hampton, to New York capitalists, through a Mr. Wallbridge and Mr. Mulholland, both of whom are bright, shrewd business men and had personally visited the property this summer. It is said plans will be arranged to work the areas on a liberal scale.

Reports of prospecting for iron in the vicinity of Lepreaux, and coal on the Oromoncto, and several other ventures in different parts of the province, are prevalent, but nothing definite is known. When it is more fully known, steps will be taken to advise you of the facts.

The Richest Mines in the Empire.

British Capital wanted for British Columbia's Mineral Development.

Attention has often been called in our columns to the fact that the rich mines of British Columbia are, many of them, becoming the property of enterprising United States capitalists. Mr. Clive Phillipps-Wolley now writes from Vancouver to the *Times* deploring this fact, and urging British financiers to send experts to the province to see its wonderful richness. He says in the course of his letter :

The minds of all English mining men appear to be so engrossed in South African ventures at present that they will pay no attention to anything else. One of the most deplorable results of this is that they are allowing the first-fruits of perhaps one of the richest mining fields in the empire to be reaped by aliens; nay, more, they are allowing a province of Canada to become American in men, manners, money and sentiment.

As long as British Columbia was only known as a silver field this was comprehensible, although our silver deposits have now proved themselves rich enough to pay, with silver even lower than it is at present. But since last year a gold-bearing belt of ore has been discovered and opened up, which, added to our gold-bearing gravels, seems likely to give British Columbia a prominent place among the gold-producing areas of the world.

British Columbia only became accessible to the world in June, 1886, when the Canadian Pacific Railway reached Vancouver. The province, which is of vast extent, is by no means sufficiently opened up by railroads, roads, and trails to-day. In spite of this, consider what has been done in British Columbia since 1890, without foreign capital (except American), by the energy of poor men and the intrinsic value of the mines. In 1890 there were no railways into West Kootenay. To-day there are three competing for her ores. In 1893 there were no shipping mines in the country. During the past twelve months, in spite of the silver panic and such difficulties of transportation as still exist, our silver-lead mines alone have shipped 24,500 tons of ore. An idea of the value of this ore may be obtained from considering a return now lying before me. A shipment of 2,114 tons, sent from seven different mines to the Omaha and Grant smelter, netted to the owners $107 per ton. This shipment is not selected for its exceptional value, but at hazard, as the first absolutely reliable statement of fact which comes to my hand. Last year a smelter, representing an investment of $750,000, was opened at Pilot Bay, close to Nelson, and not only is this to be enlarged, but within the last few weeks representatives of four of the greatest American smelting companies have been hovering about the district, their apparent aim being to make arrangements for the establishment of a great custom smelter at or near Nelson.

What has been written so far concerns our West Kootenay galena fields and the one great bornite deposit at Nelson only, but since the autumn of 1894 another belt of mineral of an entirely different character to the mineral of Slocan has been opened up. We know now that from the Kettle River to the Salmon River (a tributary of the Pend d'Oreille), at least, there is a belt of pyrrhotite, with some chalcopyrite, carrying gold in very considerable quantities, some silver, and a percentage of copper. In September, 1894, there were only four houses at Rossland, the principal camp, so far, on this belt. To-day Rossland is a town of from 1,400 to 2,000 people, growing with truly American rapidity, from which in June four of her young mines shipped to Helena and Tacoma 2,930¾ tons, of the value of $135,386. New machinery is on its way to Rossland, and this monthly output will shortly be doubled. One mine alone is under contract to the Montana Ore Purchasing Company to supply 75,000 tons during the next four years, and another, the War Eagle, has, since its purchase in December last, paid dividends amounting to between $80,000 and $90,000, thereby covering its original cost and all subsequent expenses. For this mine I am credibly informed that $900,000 is now offered, and half a million for an adjoining property. Unless readers bear in mind the time in which these things have been done, the limited population we have to draw upon, and the abnormal scarcity of cash in this country, these developments may not seem great, and yet there must be some great intrinsic value in our mineral belts. If it were not so, our mountains would not be alive with prospectors from the Cœur d'Alene, our camps with middlemen representing the greatest American mining capitalists and ore-handlers, neither should we have in such a young country so many shipping mines. In the new belt we have already the War Eagle, Le Roi, Josie, Nickel Plate, Cliff and Northern Star, whilst scores of prospects are being rapidly developed. In the silver-lead district the mines which have shipped are too numerous to mention, but the chief are the Slocan Star, Noble Five, Idaho, Dardanelles, Rueccau, Ruth, Blue Bell, and Alpha. Of these, the Slocan Star bids fair, in the opinion of the most trustworthy authority whose opinion I have heard, to rival the famous Broken Hill Mine. Scattered throughout the country are free milling properties, one at M'Kinney, on which they have sunk 150 feet, another, near Nelson, has paid for itself over and over again, and there are others at Fairview and elsewhere. Throughout the country, companies like the Parrot Mining and Smelting Company, of Butte, Montana, and mining men, are buying greedily, but every day fresh strikes are being made, prospects can be bought or bonded for a mere song, and camps like Boundary Falls, with huge deposits of comparatively low-grade ore, are neglected, because they are still sixty-five miles from a railway.

It would be unfair to the province to conclude without some mention of our gold gravels, especially as local and eastern Canadian capital is being largely employed in their development. The story of Cariboo's gold returns to the poor men who worked with pan and shovel in the sixties has been told too often to need repetition. Since 1859 British Columbia has contributed $50,000,000 to the world's store of gold, of which by far the greater part came from Cariboo. This total does not include gold taken out by Chinamen, of which it seems difficult, if not impossible, to obtain an accurate estimate. To-day machinery can be taken into the gravels of the Fraser, the Similkameen, and the Tulameen, and over a million dollars has already been expended in hydraulic works on these three rivers, whilst it seems likely that another field will be opened up this winter on China Creek, in Vancouver Island. The two great mines so far are the Cariboo and the Horsefly. Of these the Cariboo has just cleaned up $14,000, after a run of 172 hours. The clean up of another small property on which $20,000 has been expended has just come to hand. The Nelson Hydraulicing Company has cleaned up between $4,000 and $5,000 in 120 hours' run. In considering the results it is only fair to remember that none of the mines are yet in fair working order, or, at any rate, not in such a state as to make a thoroughly representative showing of what they can do when fully under way. The Cariboo mines I have not personally visited, but upon the Semilkameen the results of panning in all sorts of places, likely and unlikely, form the river bed to the grass roots, and in shafts 60 feet deep, was an average of 27 cents to the cubic yard. A large amount of platinum is also found in the gravels of the Similkameen and Tulameen, which has been sold hitherto in the local stores at $4 an ounce.

I have travelled this country now for a great many years as a mere sportsman who has gradually grown interested in its development, but I cannot help echoing the cry of every camp in our mountains. Is it not worth the while of some English capitalist to send a party of reliable experts through British Columbia to ascertain whether what is good enough for alien investors is not good enough for some of those who talk so much about the necessity of uniting the different atoms of the English Empire? At the present moment American capital is buying, Americn energy is conquering, and American people populating British Columbia, simply because she is utterly neglected by those of her own kin; and, as usual, the American is making a fortune out of the operation. Perhaps it is worth while adding that the mining fields spoken of are so situated as to enjoy the advantages of water comunication afforded by the Arrow Lakes, Kootenay River and Lake, and the Columbia River, have all the lumber they require, and deposits of coal near the Crow's Nest Pass and elsewhere which can be tapped by railways at a very small expense.

It may be stated that the great bornite mine which is mentioned above is the Silver King, which is being developed by British capital. Mr. Wolley thinks much will be heard of that mine in the near future, and Mr. P. A. Peterson, chief engineer of the Canadian Pacific Railway, who has just visited it, is also of the same opinion. He says:

The English capitalist company that owns this mine is working away with a great deal of energy, and is getting out a very large quantity of ore. It is also building what is known as a wire tramway from the mines down to Nelson, some four and a half miles, the last named place being the Kootenay River terminus of the branch of the Canadian Pacific Railway, which runs from Robinson. The Silver King Company has likewise given Messrs. Fraser and Chalmers, of Chicago, a contract to build a smelter for them at Nelson, and when this is completed it will be able to do its own smelting instead of sending ores to England and the United States.

The Silver King has already got out six or seven thousand tons which average somewhere near 5 per cent. of copper and gives fifty ounces of silver, while picked samples run as high as 15 per cent. of copper and 150 ounces of silver. This concern has, of course, done a great deal of development in the way of sinking shafts and digging tunnels, and, I believe, there are no less than 100,000 tons of ore in sight. The Slocan Star has also shipped from 6,000 to 7,000 tons of ore, and the owners are at present engaged building a concentrator half way down the mountain side, where the silver and lead will be separated from the rock. There is one of these concentrators already built at Three Forks, that serves the Idaho group of mines, which produce about 100 tons of ore per day, or equal to 100 ounces of silver, the rest being lead. There are a number of other mines in the Slocan district such as the Mountain Chief and the Noble Five, etc., all of which are producing and will continue to produce a large amount of precious metal during the present year. Capital is all that is required to render the Trail Creek, the Slocan, and the Nelson districts produce gold and silver in wonderfully paying quantities. All who have invested capital there have received large returns.

CHEMICAL AND METALLURGICAL NOTES.

New Element from Bauxite, by R. S. Bayer.—The residues after fusing or boiling bauxite from Var with caustic or carbonate alkalies, and the precipitation of the alumina by carbonic anhydride, contain a new element in addition to iron molybdenum, vanadium and other rare metals.

The new element appears to be carried down with the sulphides of molybdenum and vanadium by passing sulphuretted hydrogen through an acid solution, although it is not so precipitated when isolated from these elements.

The new element appears to form with oxygen two oxides, in the higher state of oxidation it forms a well marked acid, while in the lower state of oxidation it is decidedly basic.

The chlorides are volatile and give a well defined spectra with characteristic lines in the green, blue and violet. With alkaline sulphides the acid forms an intensely red solution, probably due to a thio-acid, as a sparingly soluble rust-coloured sulphide is precipitated by acids.

We have received an interesting little book on the McArthur-Forrest process of gold and silver extraction by J. S. McArthur. It gives a good account of the cyanide process, but of course showing it in the best possible light, while remarks on other processes, namely, roasting before amalgamation and on the chlorination process we cannot wholly agree with. For instance, in describing the chlorination process, the author confines himself to a description of the Plattner process, which is rapidly giving way to chlorination in barrels. We also take exception to the following, referring to the amalgamation of highly sulphuretted ores: "Sometimes the amount of loss may be lessened by roasting the concentrates before amalgamation, but this is by no means a perfect remedy, as the roasting removes only the volatile constituents of the concentrates, principally sulphur, while the base metals, lead, zinc, etc., are left in the form of oxide *to oxidize and waste their equivalent of mercury.*

There is one paragraph which we consider is rather a confession:—

"Under favorable circumstances the gold and the useful metals may be recovered by smelting, but these favourable circumstances, which are proximity of the gold mine to coal, clay, limestone and other fluxes, are quite exceptional, as auriferous reefs are generally found in primary formations. As before implied, chlorination is frequently inapplicable—no attempt is ever made to chlorinate gold ores containing an appreciable quantity of lead—and where applicable is always troublesome and never cheap. When this question presented itself to Dr. Forrest and myself, we tried to find some solvent which, unlike chlorine and mercury, would have a stronger affinity for gold than for sulphides. *Acting on this principle we drew out a list of all probable and possible solvents fulfilling this condition. The list included cyanides, and we found that these salts solved the problem.*"

This was the foundation of the present *patented* process.

The cost of "cyanidation" as given by statiscists in this book, appears to range from $1 to $3.75, while the recovery of gold is from 90% to 94% of the assay value.

The lowest cost of chlorination that we know of has been made by W. A. Thies, who, in 1893, practised the Mears process at the Bunkerhill mine, in California, at a cost of $3.02 per ton.

In 1894 the cost rose to $3.31, owing to the fact that there was a smaller quantity of concentrates to be treated, this cost is made up as follows:—

Labour	$2·31
Fuel	0·55
Sulphuric acid	0·24
Chloride of lime	0·21
Total	$3·31

The percentage of gold extracted is not given, but usually chlorination will clean concentrates more completely than the cyanide process.

Each process has its advantages, and one will often work economically where the other will not. Where "cyanidation" will extract 94% of the gold we should nearly always use it, but we know in many cases it will not extract nearly that amount. In cases where the concentrates contain mercury, and they often do, although we are prepared to admit they should not, the mercury coats some of the particles of gold and prevents the cyanide from attacking them. There are also certain ores which decompose the cyanide before it attacks the gold.

With chlorination, appreciable quantities of galena prevent its success, as do appreciable quantities of limestone, a mineral which luckily does not often occur with gold. Everything depends on a successful roasting of the ore.

The last issue of the Chemical Society journal is the most interesting we have seen for a long time. Foremost amongst the papers from a metallurgist's point of view, is one by Dr. Thomas Kirk Rose, of the Royal Mint, London, on "The Dissociation of Gold Chloride." As the author points out, it has often been affirmed and denied that trichloride of gold volatalizes readily, and the statements of various metallurgists as to the temperature at which the chlorides of gold are decomposed, are anything but concordant.

Dr. Rose has carried out a most elaborate series of experiments on the action of chlorine on fine gold at various temperatures. The fine gold was placed in a tube and dry chlorine gas passed over it, the tube containing the gold was placed in an oil bath and kept at a temperature of 180° C., the chlorine was absorbed by the gold and the resulting chloride was in the form of dark red shining plates and needle-shaped crystals.

The following table shows the percentage of gold volatalized in an atmosphere of chlorine, at various temperatures :—

Temperature in Degrees Centigrade.	Percentage Volatalized in 30 minutes.
180	0·007
230	0·35
300	2·32
390	1·82
480	0·88
580	0·60
590	0·58
805	0·50
965	1·63
1100	1·93

When gold chloride is heated in air no gold is volatalized below 1058°, and only about 0·02% in 30 minutes at a temperature of 1100°. "The amounts of gold volatalized vary according to two factors: (1) The vapour pressure of gold trichloride which of course increases continuously as the temperature rises; and (2) the pressure of dissociation of trichloride of gold, which also rises continuously with the temperature, but not at the same rate as the vapour pressure.

"The rise of the vapour pressure tends to rise, and that of the pressure of dissociation to reduce, the amount of gold volatalized as chloride. The vapour pressure increases more rapidly than the pressure of dissociation at temperatures below 300°, and also above 900°, but less rapidly at intermediate temperatures."

Dr. Rose's next experiments consisted of heating a mixture of mono and trichlorides of gold at various temperatures in air and in chlorine, the mixed chlorides were made by passing chlorine gas over fine gold at 210°-220°. When no more chlorine was absorbed the tube containing the chlorides was sealed, heated to 300° and the melted chlorides shaken up, allowed to cool and sampled. An analysis of the mixed chlorides gave

Metallic gold..	Nil.
An Cl	18·81
An Cl_3	81·19

The following table shows the rates of decomposition of gold chloride in chlorine gas and in air respectively :—

Temperature.	Time of Treatment.	Analysis of Product, Percentages.			Percentage of An Cl_3 decomposed per hour.
		Metallic Gold.	Gold as An Cl.	Gold as An Cl_3.	
In atmosphere of chlorine.					
165°	4 hours	....	20 11	79·89	0·40
188°	18 hours	....	21·86	78·14	0·21
190°	8 hours	....	27·06	72·94	1·27
190°	24 hours	....	37·30	62·70	0·95
In air.					
100°	7 days	....	24·33	75·77	0·04
165°	4 hours	....	28·60	71·40	3·015
168°	18 hours	....	59·59	41·41	2·72
190°	10 hours	0.12	99·88	....	....
190°	24 hours	57·88	42·12	....	....
175–180°	6 days	100·00	....	....	....
155–163°	7 days	52 23	47·77	....	....

Trichloride of gold is completely decomposed in air in 36 hours at a temperature of 200°, and at the melting point 288° in less than one minute. These experiments of Dr. Rose's bear directly upon two well-known metallurgical processes, namely, the roasting of auriferous sulphurets, and the Millar process for the purification of gold bullion. This latter process, as is well known, consists of passing a current of chlorine through molten bullion, the silver and base metals are converted into chlorides and either float on the surface of the gold or are volatalized and pass away as vapour.

Now, according to Dr. Rose's experiments the gold volatalized as chloride would be somewhere about 3·86 per cent. per hour. Of course the process does not last for this length of time, but surely an appreciable amount of gold must be lost by it.

In the roasting of sulphurets without salt the amount of gold lost would be almost nil, provided always there is no telluride of gold present. But in the case of roasting with salt it is evidently different. It would appear from Rose's experiments that the proper time to add the salt would be at a temperature of from 600° to 800°.

Paul Jaunasch gives the following method of decomposing silicates:—Lead carbonate is prepared by precipitating a hot solution of lead acetate by ammonium carbonate, the precipitates is washed with water and dried in a porcelain dish. The silicate is mixed with from 10 to 12 times its weight of lead carbonate and placed in a platinum crucible, it is heated at first gently until most of the carbonic anhydride is driven off, then at a red heat. The hot crucible and contents are thrown into cold water, treated with nitric acid, and the solution evaporated to dryness. The product is dissolved in nitric acid and water, separated from the insoluble silica, and the greater portion of the lead precipitated, by the addition of concentrated hydrochloric acid. The salts are then converted into chlorides by evaporation with hydrochloric acid, and the remainder of the lead precipitated by hydrogen sulphide. The filtrate is freed from hydrogen sulphide and then subjected to the ordinary methods for the separation of the metals.

There is an exceptionally good series of lectures being reproduced in the *Society of Arts Journal* on "Recent American methods and appliances employed in the Metallurgy of Copper, Lead, Gold and Silver," and we propose giving an extensive review of them in our next issue.

Mr. Amos P. Brown, in the *Chemical News*, gives the results of the investigations he has made on the two forms of bi-sulphide of iron found in nature, namely, pyrites and marcasite. The former resists the action of air, and when decomposed in the earth gives rise to limonite, frequently in pseudomorphs, whereas the latter oxidizes readily into a sulphate, and only occasionally yielding limonite; pyrites is obtained when ferrous sulphide is deprived of iron by ferric salts or carbonic acid, marcasite when ferrous sulphate is reduced by organic matter. From an elaborate series of experiments (each of which was repeated ten times), which consisted of shaking the finely divided minerals with aqueous solutions of permanganate of potash of different strengths and at different temperatures and then determining the sulphuric acid formed and also determining the proportion of pyrites oxidized by electricity. Mr. Brown concludes that the composition of pyrites is 4 Fe^{IV} S_2 Fe^{II} S_2 while marcasite has the more simple composition Fe^{II} S_2, or a polymeride of it.

The Necessity of Competent Geological Surveys of Gold Mines.

Mr. Nicol Brown, F.G.S., in a recent paper before the Geologists' Association of London, enunciated that geology in competent hands is the first science for gold mining, and that no sure foundation is laid for other sciences to base their work unless the preliminary work of the geologist be well done. Whether a man goes to seek fossil shells or golden sands, the same qualities are required for success, the same intimate knowledge of nature and nature's laws, without which her thrilling secrets cannot be discovered. From the want of this knowledge, the ordinary uninstructed gold-seeker always defeats the end he has in view. He works hastily, and by imperfect methods, and never stops to mark the finger-posts or compass-points, which might guide him to the object of his search. The finding of gold must no longer be left to chance, but should be the result of well-designed and well-organized efforts, and the basis of that industry, which is now being built up, rests on geological surveys made by qualified men. These are now demanded, and must be obtained, and the gold miners can well afford to pay for them, and at a different rate from what has hitherto been paid.

Directors of gold mining companies have considerable difficulties to encounter in selecting employees who understand the various departments of the work. To the uninitiated these latter appear complicated; but in reality they are simple to those who take the trouble to spend the time and labor to learn about them. Directors of gold mining companies should, however, themselves learn how to appoint their staff, and to control them by allocating to them their work in such a way as to get the best results. Instead of this, their aim has been to get what they call an "all-around' man, and thus try to shift the responsibility off their shoulders. Owing to the confusion existing in the minds of such unskilled persons as to the proper administration of gold mines, the work of the different departments has often become hopelessly mixed. By these persons the manager is expected to be a geologist, a miner, a mechanic, a chemist and a business administrator, all rolled into one; but evidently this leads to failure. Pseudo-geologists, or prospectors without adequate knowledge, have been often employed to survey and report on the properties.

Incapable persons also have been entrusted to do the industrial part of the work of mining, milling, and saving the gold. All this blundering results in heavy loss. So largely has this been the case from the earliest times, that those who have taken the trouble to enquire into the facts, taking good and bad mines alike, have often made the statement that gold costs more to produce than it is worth. Proper geological surveys, not only of the gold-bearing veins or beds, but of the enclosing rocks, must now take the place of the old prospector's empirical work in order to prepare the field for the tools of the workers of the mines, who cannot otherwise proceed intelligently with their operations. The costs of preliminary and concurrent surveys by competent geologists should always be provided for in any gold mining scheme. The expense of such surveys will be infinitesmal, compared with the money thrown away in times past on many expensive, abortive, El Dorado-like schemes.

The mining operations should be under the control of an educated and experienced mining superintendent. He must be a practical miner, and should have had experience in mining various ores in different parts of the world. It is a great disadvantage to employ a miner whose prejudices have been developed by long experience in one particular series of rocks or of the physical structure of one country. Such a man, however capable otherwise, has no resources when he comes to deal with new geological conditions. Unfortunately, many good mines have been condemned by such men. The various methods of gold mining naturally depend on the formation of the gold bearing rocks. The operations often reveal sections of the earth's crust, which when noted by the thoughtful geologist, lead to further following up of the payable deposits; if, however, these sections are left unnoticed and unrecorded, rich opportunities are thrown away.

Having "torn up the mountains by the roots," as mining was described in the book of Job, and brought the ore "to grass," the next operation is to mechanically crush it, in order to free the gold from the gangue; there is no evidence of this operation having been attempted by the ancients. The stone-breakers, mechanical hammers and various crushing appliances of all kinds do on an artificial scale what the earth's movements, the sea, ice, frost and rivers have always done with the rocks on a natural scale. The Californian stamp mill for crushing the ore is an improvement in detail and adaptability on the old Cornish mill used in tin stamping, which has been in vogue since the seventeenth century. By the stamp mills, which are at present the chief means of crushing, the ore is reduced to a fine state of sub-division, and the battery is flushed with water to act as a carrier of the finely divided ore or pulp from under the hammers. This pulp is carried over plates coated with mercury, which catches a certain amount of gold, and so saves it in the form of an amalgam of gold and mercury. The general result of this treatment is great loss in float gold, and loss of gold in slimes. A newer method, which is now attracting much attention, but may not be applicable to all kinds of ores, is to crush the ore dry, and this makes the product easier to deal with, when a percolation chemical process is used for dissolving the gold out of the ore, instead of taking it out by amalgamation with mercury.

It has been the aim of this paper to show that the chance of men finding much gold in massive nuggets, and becoming suddenly rich, has for ever vanished. To continue the necessary supply of gold, to carry on the ever-extending commerce of the world, a vast industry of the first importance, aided by many sciences, is needed to gather out the infinitely small scattered portions of gold as they exist in nature. The product in gold of the industry which has recently sprung up will afford relief to the straitened currency of the world; and as it can now be procured with the industrial and scientific certainty predicted by Jevons, the result to the world will in the near future be very great. The governor and directors of the Bank of England may hold the key of the bank's gold, but the geologists hold the golden key of knowledge to the earth's store-houses of the kingly metal, and although it cannot be counted up like gold in the bank, they, and they only, can be relied on to survey the new gold-fields which may yet be found. If this be done, the still potent survivals of mediæval or Oriental superstitions, ever ready to delude again and again a too gullable public, will definitely die out. Men cannot nowadays keep slaves to work their gold mines as of old ; but, always provided that they work upon the basis of proper geological surveys, the mining, mechanical, the electrical engineers, and the metallurgical chemists, with all the far-reaching fingers of their various sciences, can gather out the countless small particles of gold from the rock matrices, and pile them into the bank storehouses. Industry must be set off against industry ; our future gold, got by well-directed industry, will represent the result of honest men's toil. Gold so obtained will reach a steady value ; it will neither become greatly "appreciated" nor "depreciated," as the supply will constantly keep pace with the requirements of commerce ; it will help to keep the countless mills of many different industries in continuous motion, without intermittent periods of fluctuating trade, and thus bring benefits to many people in all parts of the earth.

Mine Sampling.

The readers of the prospectuses of mining companies, of which there are at present no lack, are familiar with the phrase that "samples taken from the mine have been assayed by Messrs. So-and-So, and have yielded" so many ounces or pennyweights to the ton, as the case may be. Now, the name of the assayer is a guarantee that the samples submitted to him contained no more and no less than the amount certified. It is, however, in no sense a guarantee that the samples so tested represent the actual average value of the lode. This latter depends for its accuracy not only upon the sampler, the conditions under which the samples were taken, but also upon the quantity of the sample, and whether it was taken from a heap of ore already mined and accessible outside the mine, or from the lode itself as standing and exposed in the workings. Now the sampling of a heap of ore is of itself a difficult process, but with care and the exercise of patient skill, judgment and supervision on behalf of the sampler, and the absence of interested parties, a tolerably correct idea of its average mineral contents can be arrived at, and is, indeed, a common occurrence amongst mineral merchants, who keep men and appliances especially for this work. In the mining and smelting districts of America mills are erected solely for this purpose, and the whole process is automatic and mechanical. The ore is crushed in bulk—that is, in quantities of from 50 tons upwards—and as in the process of sampling its quantity is reduced, great care is taken to prevent any tampering with its quality, until, at last, a finely-crushed sample of a few pounds in weight is obtained, which accurately represents, by its mineral contents, that of the total amount operated upon. In short, it is a recognized rule that, unless the ore is thus treated in a sampling mill erected for the purpose at great expense, a correct idea of its value cannot possibly be obtained. In spite of all this, we are brought face to face with presumably competent men, who, in the course of an hour's ramble through a mine, knock off a stone here and there, and so pretend that they have procured an average sample of a mass of ore, amounting to many thousands of tons. The idea that such an haphazard way of doing business can afford any reliable data is, to us, so prepostorous that we have long ago ceased to place any confidence whatever in the results so obtained. They are, in short, as likely to show on the one hand that the mine is too poor to work, as they are, on the other, to prove that it is a perfect Eldorado. Only by a most improbable concurrence of circumstances can they possibly give an accurate estimate of the value of the lode. Apart from the treatment of a bulk sample of several tons in a sampling mill, there is only one reliable method of ascertaining the commercial value of the ore—and that is, by milling a large quantity of it. If there is no mill on the spot, it is far wiser, and in the end cheaper, to go to the expense of conveying the ore to a neighboring mill than to risk the expenditure of public money on results obtained by crude, imperfect, and unreliable methods. In the case of a mine with a mill already at work, the duty is simplified ; as, if it is not advisable to accept the results obtained by past operations, it is a comparatively easy matter to clean out the mill, and put through a hundred tons or so obtained from various parts of the workings. In the case of gold ores where Government returns of the bullion obtained in the past are usually available, is it not impossible to confirm the number of tons said to have been crushed in order to obtain that amount by measurements of the stopes, levels, and shafts from which the ore was abstracted, and so obtain the average yield per ton upon which it would be fair to base an estimate for the future. If these returns are available, and can be utilized for the purpose, it would be manifestly absurd to neglect or ignore them ; and yet we have known of an expert under such conditions ignoring the past, and the milling returns actually obtained for several consecutive years up to the very date of his examination, and basing his opinion, to a large extent, upon a sample of a hundredweight or so of the ore obtained during a hurried examination, with the curious result that while his sample showed that there was no gold in the ore being treated, the actual milling returns for the same time yielded considerably over half-an-ounce to the ton.

In every well-managed mine the process of sampling is practically a continuous one, for in order to arrive at the difference between the amount of gold actually contained in the ore and that extracted from it by the milling operations, in order to ascertain the amount of loss, a careful and systematic sampling of the crushed ore, and also of the tailings, is a part of the routine of the day's work. This process is very clearly described in a paper read on April 21st last by Mr. A. C. Claudet, before the Institute of Mining Engineers. When dealing with the sampling of the ores and tailings at the Mesquital del Oro Gold Mine (State of Zacatecas, Mexico), he said that "as a general rule it is found that the gold extracted, added to that left in the tailings, approximates pretty closely to the assay of the ore before entering the batteries ;" in fact, as we understand, there is rarely a difference of 5 p. c. between the two. This proves that the method of sampling is nearly perfect, even though it is not an automatic one, but is effected by taking a couple of shovelfuls of the crushed ore every two hours, just previous to its entering the feed hoppers. An iron bin is fixed between each head of five stamps and the sample is put into this, making four shovelfuls for each 10 head of stamps per two hours. At the end of each shift of 12 hours the bin is emptied, its contents well mixed and quartered down, the final sample from each 10 heads weighing about 20 lb. The whole of the battery samples are mixed together in the assay office, crushed down to the size of peas, well mixed and again quartered down until reduced to an amount of about 2 lb, which is the representative battery sample for the shift. A portion of this is assayed, and a portion kept to be mixed with all the other samples taken during a month's run so as to form the sample of the mineral crushed in the month. In like manner, a cupful of tailings from each battery is taken every two hours, and when dried forms the tailings sample, from which, again, a portion is taken to make the monthly sample. It is very evident that, if it requires a careful and long continued process like the above to arrive at the average value of the ore, it is practically impossible for the cleverest expert to obtain even approximate results by any less carefully conducted operation ; while to expect to do so by merely dipping a shovel into an ore-bin is a farce, and is as likely to yield as valuable an idea of the contents thereof as the dipping of one's hand into a lucky-bag at a bazaar. Enough has been said to prove that, wherever possible, bulk samples only should be dealt with, and can alone give fairly accurate results. It will, however, sometimes happen, that there are no means of handling the quantity necessary, and for many reasons it may be necessary to arrive at approximate results by simpler means, such as by sampling an ore heap and assaying the sample. The process seems simple, but it necessitates the cutting of a trench straight through the ore heap, the reducing by hand to the size of macadam, or under, and the quartering of the large sample so obtained. The reduced sample must now be crushed down still finer well mixed and quartered down again until the amount is reduced to 20lb or so of ore. This may be still further reduced, but great precautions must be taken to prevent its being tampered with, as the insertion of a few grains of gold by any of the well-known dodges would vitiate the results.

The sampling of a mine itself is a long process, and will entail the cutting across of the face of the lode at regular and frequent intervals, the careful collection of the whole of the mineral so obtained, and the reduction of its bulk afterwards by the same system of crushing and quartering-down as before. If the ore occurs in rich shoots, then the samples from them should be kept separate from those of the poor ones, so that the extent and value of each may be known. Some experts say in their reports that "after picking out all pieces of visible gold the sample assayed," &c., but if the sample has been fairly taken it seems just as absurd to us to pick out the gold because it is visible, as it would be to take out the sterile pieces of quartz. In both cases the result would be unreliable as indications of the value of the ore. The sampling of a mine is by no means to be lightly undertaken ; it is a most serious matter, and will require patient care and occupy many days ; but seeing that the expenditure of large sums of money depends upon the results, we would enforce an opinion that the work should be entrusted only to well qualified men, and that they should be prepared to go minutely into the whole question, and spend whatever time on the spot which may be necessary to obtain reliable results.—*Mining Journal* (London).

The Spontaneous Combustion of Coal Cargoes.

The following excerpts are from a paper read before the Institution of German Engineers, by Mr. Hermann Pape, C.E. :—

The first part of the paper deals with the theory of the spontaneous combustion of coal in vessels, and in the second part the author propounds a method for the prevention of the danger. He arrives at the conclusion that the first and most important condition for an efficient protection of the coal cargo in ships is to prevent as far as possible the absorption of oxygen. This can be done either by shutting off the atmospheric air from the ship's hold, or by changing the surface of the coal so that during the voyage little or no oxygen is absorbed. Mr. Pape, after showing that it is practically impossible to prevent the absorption of oxygen by providing a neutral atmosphere in the vessel, proceeds to describe a new invention, which he claims to be suitable for removing in a most simple and safe manner all the difficulties which have as yet stood in the way of the effective protection of coal ships. This is the invention of Mr. Behnke, manager of a large chemical works in Germany. The process, upon which Mr. Behnke's proposals are based, is shown by the following experiment : If a glass vessel is partly filled with carbonic acid, and vapour of ammonia is brought into the vessel, the shell of the vessel or the surface of anything brought into the vessel is immediately coated with a thin white film. A closer investigation shows that this film consists of carbaminate of ammonium ($NH_2\ Co_2\ NH_4$). If then some moisture is made to act upon the white film, the latter does not change its appearance, but its chemical constitution is altered. It is transformed into carbonate of ammonium $[(CO_2)_2\ (NH_3)_3\ H_2O]$ or sal volatile. If afterwards fresh carbonic acid is allowed to act upon the transformed film—for instance, by making up enough carbonic acid to maintain the same percentage in the interior of the testing vessel—the white coating is still further changed, finally bicarbonate of ammonium ($CO_3\ (NH_4\ H)$ being formed by the additional carbonic acid. If now the vessel, the shell of which is covered with the thin coating of salt of ammonium, is heated, there will appear an evaporation of this salt at a temperature of about 158 degs. Fahr., the vapour of the salt escaping quickly out of the vessel into the air and causing an odor of ammonia. By the foregoing experiment, the principal idea of Mr. Behnke's invention is shown. His process consists in providing in the ship's hold an atmosphere containing carbonic acid, and then forming the salt just described by the introduction of vapour of ammonia. This salt precipitates upon the coal at first in the form of carbaminate of ammonium in very thin layers ; later on it takes up moisture from the atmosphere between the coal and is thereby transformed into carbonate of ammonium, while finally, by excess of carbonic acid in the atmosphere of the ship, this salt is transformed into bicarbonate of ammonium. In this form the thin coating remains until the voyage is finished, and the presence of this coating is said to entirely prevent the absorption of oxygen. If, says Mr. Pape, the putting into practice of the Behnke principle is entertained, the question will at once arise as to the best way in which an atmosphere containing sufficient carbonic acid can be produced in the ship. This is proposed to be done by introducing gases obtained by the combustion of coke. By burning good coke the fire gases will contain 14 to 16 per cent. of carbonic acid, 0·5 to 4 per cent., of oxygen, 0·5 to 2 per cent. of carbon oxide, and 79·5 to 81 per cent. of nitrogen, and the combustion of 240 lb. of coke will furnish sufficient gases for filling up the whole air space in a cargo of 1,000 tons of coal. To ensure having an atmosphere charged with enough carbonic acid, it would seem desirable to introduce double the theoretical quantity of coke gases ; hence every 1,000 tons of coal would require 480 lb. of coke. The ammonia necessary to form the salt already mentioned is introduced into the ship in the shape of liquid ammonia by means of the pipes used for the coke gases. The ammonia evaporates immediately after being released from the high pressure existing in the cylinder and spreads quickly through the coal. The quantity of ammonia required for the process will be, as is proved by trials made on a large scale, about So lb. for every 1,000 tons of coal. As to the combustion of coke, this can either be done in an auxiliary boiler or in a furnace built for the purpose. The introduction of the gases is effected by a fan. It is suggested either that ships should have on board a special coke furnace with fan, or that the application should be made while the vessel is still in the harbour by a tug boat provided with the necessary plant.

Machinery Foundations.

Walter H. Mungall, B. Sc.*

The importance of a sound and unyielding foundation for machinery or other erections has long been realized, and at an early stage in the work of opening and fitting a new colliery, the engineer has to turn his attention to this subject. The first engine that is to be used in sinking a shaft requires to have a foundation previously provided for it. Boilers and chimneys ; the permanent winding, pumping, and haulage engines ; head-gear and screening plant all require foundations. In the present

* Paper before the British Society of Mining Students.

article, the subject will be dealt with only so far as it lies within the province of the mining engineer, and it is not intended to enter into any discussion of the theory of foundations.

A foundation in its simplest form consists of an excavation in the ground of such form and dimensions as will give a firm base for the superstructure. Such a foundation is all that is required for comparatively light structures, not subject to sudden and severe strains. But for most structures about a colliery such a foundation is quite inadequate, and the excavation is partially or completely filled with some material which will form a firm and solid base. In many cases, as for example in the case of a pulley frame, the area of the base of the structure is small in comparison with the weight upon it, and the pressure per unit area is consequently great, greater often than simple earth foundations can resist. To reduce the pressure per unit area it is customary to form the excavation of sufficient size, and subsequently to fill it with some solid material as masonry, brickwork, or concrete, through which the pressure is distributed to any desired extent. Before proceeding with the construction of foundations, the first thing to be ascertained, after an acquaintance with the nature of the ground, is the approximate weight to be supported, and the foundations must be so designed that the pressure per unit area will be well within the limits of safety. The direction of the pressure must also be taken into account, and the base of the foundation should be formed as nearly as possible at right angles to the direction of pressure upon it. As a general rule also, the line of the resultant pressure on a foundation should pass through the centre of gravity of the foundation, or as near thereto as possible.

In some few cases a firm and sufficient foundation readily obtainable on rock, in which case all that is necessary to prepare it for the superstructure resting on it, is to cut away all loose or decayed parts, and to hew or dress the surface of the rock to suit the form and pressure of the structure to be erected. When the surface of the rock is irregular, it may be necessary to fill hollows in it with masonry or concrete. It is customary in engineering practice to allow for stone structures a factor of safety of not less than eight, and for foundations on rock the pressure should not exceed, at any point, one-eighth of the pressure required to crush the rock. Experiments on the crushing pressure of rocks have from time to time been made by various engineers of eminence, the average results of some of which are given in the subjoined table :—

TABLE OF THE STRENGTH OF ROCKS.

		Crushing Stress. Pounds per square inch.
Sandstone	(strong)	5000 to 9000
do	(weak)	2000
do	(ordinary)	3000 to 5000
Limestone,	compact (strong)	8000
do	magnesian (strong)	7000
do	do (weak)	3000
do	granular	4000 to 4500
Chalk		300 to 400
Whinstone	(basalt)	9000 to 17000
Granite		6000 to 11000

Where the rock surface is not accessible for forming the foundation, the base of the structure has to be rested on the earth above the rock, and the total pressure must be more or less distributed as the earth is softer or firmer. In firm earth, such as hard clay, clean sharp sand, or firm dry gravel, the greatest pressure in general engineering practice is from 2,500 to 3,500 pounds per square foot of bearing surface. For a superstructure that is in itself heavy, or that has to support a heavy load, or that is liable to severe strain, the foundation base must be made of such area that the pressure per square foot will not exceed the above limit. Usually the footings or lower courses of ordinary masonry or brickwork, as of an engine house, have an additional breadth or "spread" equal to one-and-a-half times the thickness of the body of the wall when built on compact gravel, or of twice that thickness when built on sand or stiff clay.

Before building on *soft* earth, additional precautions must be taken with regard to the foundations, and some other expedients must be adopted than those applicable to firm earth foundations. Of course there are degrees of softness, and no general rule can be laid down applicable to the variety of cases that may occur in practice. The simplest class of foundations on soft earth are those already referred to as applicable to firm earth, with this difference, that the base must be further increased to reduce the pressure per unit area. When softer earth, as peat moss, soft alluvial clay or silt, with, in some cases, a natural slope of one vertical to eight or ten horizontal, is met with, of considerable depth, other methods have to be adopted. These generally entail the use of timber or iron. Timber platforms are usually constructed by forming a grating of crossed beams of elm or oak which in turn is covered by planking on which the superstructure rests. The beams employed are usually from 10 to 12 inches square, and laid about 3 feet apart, the spaces between being filled with concrete.

The method usually adopted, however, for securing a good foundation in very soft ground is by piling. Piles are usually of square or round timber from 6 to 9 inches diameter for piles from 6 to 12 feet long, and larger in proportion to the length, the ratio of diameter to length being in general about one to twenty. In setting the piles they are placed as close together as practicable. When piles are driven to form a rectangular or circular foundation, the outer circuit of piles should always be driven first. The work being finished at the centre. The piles may be surmounted by a platform as above described, or simply by a layer of concrete. The most suitable timber for making piles is elm. In general practice the limits of pressure on pile foundations may be taken at 1,000 pounds per square inch of head area when the piles are driven till they reach firm ground, or 200 pounds per square inch of head area when the frictional resistance between the timber and the earth is the only support. In all cases where timber is thus employed in foundations, care should be taken to keep it entirely removed from the influence of the atmosphere, and to keep it wet, otherwise it will soon decay.

Engine foundations, as a rule, require to be raised sufficiently high above the surrounding ground to give clearance for the fly-wheel, drum, or gearing, or for other purpose, as also to form a sufficient weight to which to fix the engine. Engine foundations may be constructed of timber, brickwork, masonry or concrete. For permanent work timber foundations are not to be recommended, as they are liable to early decay, but for temporary winding or pumping engines at a sinking shaft they form a convenient, simple and cheap foundation. They are easily built and easily removed, and the material may subsequently be used for similar or other purposes.

One form of engine foundation, now almost obsolete, was built of ashlar masonry, the stones being of large size, each measuring about 10 cubic feet, the usual dimensions being 4 feet by 2 feet by 15 inches thick. Stones of larger size are more expensive, and were consequently seldom, if ever, used. Undoubtedly this makes a very good foundation, but it is costly, and it is now generally superseded by brickwork or concrete.

Brickwork built with Portland cement mortar is in very general favor, and forms an excellent foundation. The bricks should be tightly built, the joints not exceeding quarter of an inch in thickness, and the whole structure well bonded together so as to form, as nearly as possible, one solid block. The cost of this kind of engine foundation is considerably less than one of ashlar masonry.

For engine foundations, and, indeed, for all sorts of foundations about a colliery, there is much to recommend the use of concrete. It forms the best foundation, and is less costly than either ashlar masonry or brickwork. Concrete is essentially a species of rubble building, the stones of which are cemented together by a mortar, usually of Portland cement and sand or fine gravel. About a colliery where, as a rule, a plentiful supply of sandstone is readily obtainable, especially during sinking operations, it may with advantage be used in the manufacture of concrete. A quantity of stone is broken to about the size of ordinary road metal, or from 1½ to 2½ inches diameter. This is mixed with certain proportions of clean sand and of Portland cement, the proportions of the various ingredients varying with the purposes for which the concrete is to be employed. For ordinary foundations the proportions are generally about four parts by measure of broken stones, one part of sand, and one part of cement. These, after being thoroughly mixed, have sufficient water added to make the whole a plastic mass, which is forthwith transferred to the excavation or other receptacle previously provided for it. At the same time, a number of large stones may with advantage be thrown in, care being taken that they are thoroughly bedded in the concrete, which should also fill all interstices between them. When using sandstone for making concrete, it is not generally necessary to add sand, as in breaking the stone a quantity of sand is produced, unless the stone be very hard. By a little experience one can readily estimate whether there is a sufficient quantity of sand among the broken stones, and it becomes unnecessary to measure them out separately. Broken bricks, blast furnace slag, limestone and other materials are frequently used for making concrete. It should be noted that the concrete occupies only about two-thirds of the volume of the ingredients when unmixed.

When concrete foundations have to be raised above the level of the surface, a casing, usually formed of planks, has to be erected, of the form and height of the monolith, into which casing the plastic concrete is placed. After it has sufficiently set to permit of the casing being taken away, this should be done.

In conclusion it may be useful to compare the cost of building engine foundations of the three classes referred to. For a set of coupled winding engines, each foundation will contain about 40 cubic yards, or say 80 cubic yards in the two, and the total cost will be approximately as under :—

80 cubic yards ashlar masonry	@ 55/-	=	£220 0 0
80 " brickwork in cement	@ 16/-	=	64 0 0
80 " concrete (5 to 1)	@ 9/-	=	36 0 0

Water Power Applied by Electticity to Gold Dredging.*

By ROBERT HAY, M. Inst., C.E.

In many mining districts there are deposits of gold which cannot be worked owing to the difficulties of transport and the dearth of fuel. The application of water power transmitted to a distance by electricity is, therefore, a subject which may well command attention in well-watered countries like New Zealand, where a plentiful supply of power is obtainable ; for intervening hills and valleys form no obstacle to its transmission, there being few districts through which light wires and poles cannot be easily carried. The plant described in this paper is the first of its kind constructed in New Zealand. It was designed by the author for gold dredging on the River Shotover, at a point about thirty miles from its confluence with the Kawarau River and twenty-five miles from Queenstown, a small town situated on Lake Wakatipu, which lies about 1,000 ft. above sea-level. The Shotover runs through rugged and inhospitable country, generally in precipitous rocky gorges, and is only accessible by tracks cut down the leading spurs and gullies. Since the dredge commenced operations, however, a mountain road has been constructed at a considerable elevation above the river, and extends some twenty miles towards the upper Shotover dredging ground, opening up to some extent the interior of that part of the country. All the bucket, grab and suction dredges hitherto employed in New Zealand have been actuated by steam power, bituminous coal, lignite or firewood usually being fairly plentiful, and accordingly moderate in cost. In the case referred to, however, fuel could only be obtained at prohibitive prices, as it would have been necessary to transport it to the dredge for long distances over the mountain tracks on the backs of horses. Water power in a convenient form was found to be available at a branch creek, but for many reasons it could not be applied directly to dredging. It was therefore decided to transmit the water power by electricity to the dredge in whatever part of the river it might be working. The water was obtained from a creek one and a-half miles, and was brought, by a race cut in the side of the hill, or, through places where the ground was too precipitous or loose to carry the race, by a timber flume, to a pressure tank situated at a point 524 ft. above the generator house. The race is 2 ft. 6 in. deep, and 3 ft. wide at the bottom, and the sides are cut with slopes of 2 in 1. The flume is rectangular in cross-section, 2 ft. deep and 3 ft. wide, and in places where it could not be wholly set in, a cutting along the side of the hill, is carried, partly upon trestles standing about 6 ft. apart. The pressure tank is 20 ft. long and 12 ft. wide at the bottom, and has sides with slopes of 1 in 1 and 2 in 1. The water passes from the pressure tank through a bell-mouth covered by a wrought iron grid, and is carried in steel pipes to the generator house. The pipes are of rolled steel of 16 and 11 Birmingham wire-gauge, with double-riveted longitudinal seams and single-riveted circular seams with 1½ in. lap. The pipes are each 19 ft. 6 in. long over all, and are jointed with wrought iron flanges riveted to the pipes. The internal diameter of the main pipe is $14\frac{3}{16}$ in. The quantity of water available in ordinary seasons is 240 cubic feet per minute; but in dry weather after a fine winter, when the snowfall has been light, the supply falls to about half that quantity. This, however, is sufficient to develop the necessary power. The generator-house is situated about midway between the ends of the portion of the river to be worked, which is about four miles long. The prime mover of the generator-house is a 4 ft. Pelton water wheel, on the buckets of which the water impinges from a 1½ in. nozzle at a pressure, in the pipes outside the station, of 228 lb. per square inch. The Pelton wheel drives by belts, two Brush-Victoria, series-wound dynamos, which, when working at their normal speed of 700 revolutions per minute, give each an electromotive force of 650 volts and a current of 40 amperes, or together a total electrical output of nearly 70 horse power. The two dynamos are coupled in series. A Buss-Sombart tachometer, driven from the armature shaft of one one of the dynamos, indicates their speed, while a Soames-Nalder ampere-meter and a Cardew voltmeter (the latter reading up to 1,400 volts) indicate the current and electromotive force respectively. The Pelton wheel has no automatic regular, as the work required of it is fairly constant. It was necessary, however, to provide against the possibility of an abnormal increase of current, due either to accidental short circuiting of the line wires

*A paper read before the Institution of Civil Engineers in conjunction with the paper on "Electrical Haulage at Earnock Colliery."

or to the sudden arrest of one of the motors, which might result in damage to the generator armatures; and to provide also against racing of the Pelton wheel and dynamo, which would take place if the circuit was broken or the load suddenly thrown off one of the motors by a belt leaving the pulley. This has been accomplished in the following manner. Two electro-magnetic switches are placed in circuit with the dynamos and motors, and are so adjusted that, in the event of the current increasing to 3 amperes above its normal amount, one of them, and in the event of it decreasing to 3 amperes below it the other one, disconnects the line and motors from the circuit and throws into it in their place a set of iron wire resistance coils, constituting an artificial load of the normal amount. If anything occurs to the line of motors to cause an abnormal increase or decrease of current, the dynamos are therefore automatically protected and continue to work as if nothing unusual had occurred. When either of the switches comes into action, an electric bell calls the attention of the attendant. The contrivance has been found to answer well in practice, and has on several occasions saved the dynamos from the risk of damage. The conductors between the station and the dredge form a completely metallic circuit, and consist of bare copper wire of No. 4 S.W.G. supported upon Johnson-Phillip fluid insulators. The supports are old 40 lb. rails, with a short hardwood cross-arm bolted to each about 2 ft. from the top; this arm carries the insulators for the conductors, while a third insulator, bolted to the top of the rail, carries a telephone wire connecting the generator-house with the dredge, the length of line being about two miles. Between the ends of the conductors on the bank and the motors in the dredge the two cables consist of seven No. 16 copper wires, and are heavily insulated with vulcanized indiarubber. The shore ends are clamped to the conductors near to one of the poles, a supplementary pole having to be used occasionally when the river bed is too wide to admit of a single span to the dredge. The other ends of the cable pass over insulated pulley-blocks and are coiled as the dredge moves towards or from the shore. The electric motors, of which there are two, are also arranged in series and are exact duplicates of the dynamos, the object being to make the various parts of the machinery interchangeable, and to avoid a multiplicity of spare apparatus. A spare armature and field magnet are provided which will fit any one of the machines. One motor drives directly, through a belt, a centrifugal pump; whilst the other, geared to an intermediate shaft, drives the buckets, winches and revolving cylinder of the dredge. As it is sometimes necessary to vary the speed or to stop the motor that works the buckets, a variable iron wire resistance is provided by which its field-magnet coils can be shunted. The motor that drives the pump acts as a current-regulator, for, when the bucket motor is switched off, or its speed varied, the pump motor absorbs the surplus electrical energy—revolving faster and causing the pump to throw more water, which, however, does not cause inconvenience. By this means great simplification in the working of the plant is attained—an important factor when electrical apparatus is placed in the charge of unskilled hands. The frames and platof the dredge, which is 80 ft. long and 20 ft. wide, are entirely of steel, and where possible, all the framing, ladders, buckets, etc., are constructed of the same material. The buckets, which have each a capacity of 3½ cubic feet, are filled and discharged at a rate of about twelve per minute. This gives a lifting capacity, while dredging to a depth of 20 ft., of more than 90 cubic yards per hour, which is as large a quantity as can be economically treated on the tables for gold-saving purposes. The winches have separate barrels for the quarter, head and hoisting lines, which are of steel wire, and each barrel is driven by a large worm wheel. A vertical shaft carrying a worm wheel is connected with bevel-wheels below the deck, which are provided with friction clutches so arranged that the barrels can be thrown in or out of gear by moving the winch handle to one side or the other, all the winches being driven by a shaft below the deck. The dredgings, boulders and gravel are delivered into a revolving cylinder 10 ft. long, constructed of bars set ¼ in. apart. Through these bars the gold and finer sand pass on to the tablos, the stones and debris being retained and afterwards discharged direct into the river through the stone shoot. The tables are set at an inclination of 1 in 12 and are covered with baize upon which the gold is caught. The cloths are washed into tubs at intervals of eight hours and are then replaced on the tables. A 16¼ in. centrifugal pump, driven at a speed of 600 revolutions per minute and with a lift of 16 ft. from the water level, supplies about 2,000 gallons of water per minute to the revolving cylinder. The dredge is lighted by two 10-ampere Brush arc lamps included in the power circuit in multiple series with the motors. They are controlled from a small switchboard on the vessel. A resistance coil to take 20 amperes is arranged as a shunt on the lamps, while the remaining 20 amperes is divided equally between two circuits, in each of which an arc lamp is placed. The switches are arranged so that if one of the lamps is switched off an equivalent resistance is thrown into the circuit in its place, the current in the circuit of the other lamp remaining ununaltered. When the lamp is switched off it is entirely disconnected from the power circuit, so that it may be tauched without danger of unpleasant shock. A third switch disconnects the resistances and lamps from the power circuit during the day time, when the lamps are not required. The full available output of the plant is not utilized and a reserve of power is always maintained. The working duties of the plant as observed are:—

Pressure of water in the pipes	228 lb. per square inch.
" at the valve	195 lb. "
" at the nozzle	188 lb. "
Speed of the Pelton wheel	447 revs. per minute.
Water used per minute	108 cubic feet.
Power of the Pelton wheel	88 horse power.
Total electromotive force of the dynamos	1,170 volts.
Total current of the dynamos	30 amperes.
Total electrical output	47 horse power.
Loss of power transmitted through two miles of line	5.2 horse power.

The cost of the entire installation was:—

Dredge	£2,600
Race and flume	500
Intake, pipes and valves	600
Electrical plant	2,500
Cartage of material to the site of the works	800
Total	£7,000

The cost of working the machinery with three shifts of eight hours each, as obtained from the results of three years' work, has been:—

	Per week.
Wages, including dredgemaster and electrician	£25
Renewals, maintenance, oils, brushes, etc	5
Management, office, rates and taxes	5
Total cost	£35

Notes on Modern Steel Works Machinery.*

By Mr. James Riley, Glasgow.

Amongst the many results of the introduction of mild steel into engineering work may be mentioned the development of the various mechanical appliances used in the process of manufacture of that metal into the finished forms of sectional bars, plates, &c. As engineers have become better acquainted with its many excellent qualities, and have realized the possibilities opened up by its use, their demands on manufacturers have steadily increased for plates and bars of greater area, strength and weight. Conversely, manufacturers have stimulated these demands by costly outlay on improved machinery, designed to deal with masses and weights which but a few years ago would have been looked upon as unattainable. This continuous emulation has resulted in the massive installations of machinery to be found in the most modern steel works.

Rolling-mill Engines.—The improvements or modifications which have been made of late in rolling-mill engines have been in the direction of largely increased strength and power, and of careful attention to the designing of details, these latter perhaps small in themselves, but in the aggregate having an important bearing on the economical working of the engines, and on the diminution of the cost of maintenance. In these days of keen competition, when rigid economy is essential in order to reduce costs to a minimum, it is important that the consumption of steam should be reduced to the lowest possible; hence for pull-over or non-reversing mills compound condensing engines have been introduced with automatic valve-gear, which are working with a consumption of not more than 3 lb. of fuel per indicated horse-power per hour, in place of the old wasteful engines which consumed from two to even four times that quantity. With reversing-mill engines also attention has been turned to the economizing of steam, and trials have been made with compound engines. Compound reversing engines have not proved economical, when applied to mills—such as cogging or roughing mills—where the pieces being rolled are of short length and necessitate frequent reversals; while their use has been accompanied with troubles and difficulties in other directions, which have more than counterbalanced the small economies possible. Where water is available in sufficient quantity, it has beee utilized in condensers, connected either with single engines or with several engines from which the exhaust steam is led to the condensers at a central station. The use of central condensing stations for a number of engines appears to have received more attention on the continent than in this country: it is stated that recently this plan has been adopted there in several instances, and with satisfactory results both in economy and otherwise. The only instance known to the author where the plan has been adopted on a large scale in this country is at the North-eastern Steelworks at Middlesbrough, where a central condensing and pumping station of considerable magnitude has been put up by Mr. Cooper; and, although no definite statement has yet been made as to results, they are believed to be not unsatisfactory. The consideration of rolling-mills will here be limited to those engaged in the production of plates; and cogging mills are naturally the first to be dealt with.

Cogging-mills.—In the earlier days steel slabs to be rolled into plates were made from ingots under the hammer. Labor difficulties and possible economies led the author early in 1884 to put down at Blochairn Works the first cogging-mill used for this purpose. Recent slab-cogging mills are in all essential features like that pioneer mill, but are much larger and stronger, and therefore are capable of dealing with heavier ingots, yielding much larger and heavier slabs. Modifications have also been made in the machinery for tilting up the ingots and slabs for alternate edge and flat rolling.

A good example of a slab-cogging-mill was made recently by Messrs. Lamberton & Co. for the Wishaw Steelworks. The rolls of that mill are 8 feet 6 inches long and 40 inches diameter, and at both ends have grooves in which slabs 54 inches wide can be rolled on edge. The housings for both rolls and pinions are massive, and well fitted for their work. The pinions of cast steel are 48 inches in diameter, and have helical teeth 36 inches long, with shrouds or flanges at the ends. The spindles are of steel; the upper has spherical ends, and is supported from the pinion housing at one end and from the top-roll chock at the other. The mill is fitted with screwing-down gear, driven through gearing by a pair of steam-engines; and an indicator is fitted to guide the screwer. Live rolls of steel are fitted back and front of the rolls, and are driven by a steam-engine with cylinders 9 inches diameter by 15 inches stroke through gearing in the ratio of three to one. In front of the mill is a set of tilting machinery. The turning levers are placed on movable carriages, which traverse to and fro across the front of the rolls as required, being actuated by hydraulic power. Thus the ingot or slab can not only be turned from flat to edge or *vice versa*, but can also be traversed from one end of the rolls to the other. The cradle for receiving the ingot and lowering it upon the feed rollers is of massive character, being designed to deal with ingots up to 10 tons in weight. It is controlled by hydraulic power acting through a ram, which carries a sliding block taking on to the pin of a crank fitted on the axle of the cradle. The mill is driven by a pair of massive engines having cylinders 46 inches diameter by 60 inches stroke, and gearing in the ratio of one and three-quarters to one.

A cogging of quite a different kind was designed in 1890 to meet some special requirements at the Blochairn Steelworks, and to embody some modifications suggested by the author's experience with the ordinary cogging-mill. Up to that time the widest slabs in cogging-mills did not exceed 36 inches. Slabs of much greater width were then required under special circumstances; and it was decided to adapt the mill to produce them up to 60 inches wide. It was also decided not to turn them up on edge, thus dispensing with the necessity for the powerful and somewhat cumbrous, as well as expensive, tilting gear which would have been required for such wide slabs. Furthermore, experience had shown that in the course of years the cost of maintenance of the live-roller gearing was considerable; and it was decided to dispense with this, and to adopt other methods of moving the ingots and slabs to and from the mill. These considerations led to the mill being made of the universal kind, with one pair of horizontal rolls for work on the flat, and one pair of vertical rolls for work on the edge of the slabs. Every part of this mill is made of steel. The housings are massive and are fine examples of the steelfounder's art. Besides the usual provisions connected with horizontal rolls, the housings have also provision for the footsteps and bearings of the vertical rolls, as well as for the strong horizontal shaft by which the latter are driven. Furthermore, one of the vertical rolls is made to move forwards and backwards across the mills, so as to put work on the edges of the slabs, and has a traversing motion through 28 inches, so that slabs can be made of any width from 60 inches down to 32 inches. With these arrangements it was contemplated that armorplates up to nearly 5 feet wide might be rolled in this mill, with their edges so well finished that comparatively little machine work would be required upon them. With a view to the transverse motion of the vertical roll, provision was made in the housings for the necessary screws and nuts by which it is effected, as well as for the slides and guides necessary for keeping the roll in the true vertical plane. Hence it will be seen that,

* Abstract of a paper read before the Institution of Mechanical Engineers, Glasgow, July 30, '95.

in order to meet these requirements, as well as some other details, the production of these housings was a work involving no little skill and anxiety.

Screwing-down gear for the horizontal rolls is placed in the usual way on the top of the housings. On the housing and side frame of the mill is arranged screwing gear for setting up the vertical roll transversely, and simultaneously for setting up the necessary guides for the slabs, these guides extending a considerable distance in front and at the back of the rolls. Both sets of gear are driven by a small pair of engines through gearing. They can be worked together; but the practice is not to work them simultaneously, but alternately as required, so that work can be put on the flat or edge of the slab at choice. To this end clutches are arranged on the shaft of the small driving engines.

The horizontal rolls are 28 inches diameter, and the vertical rolls about 21 inches The latter are driven by bevel wheels on a horizontal shaft, which extends to the pinion housings and receives its motion through a pair of wheels, one on its extreme end, and which works into another keyed on the shaft of one of the mill pinions. This outer end of the driving shaft is carried in bearings formed in the pinion housings. As one of the vertical rolls has a traversing motion, the bevel wheel driving it must necessarily slide along the shaft. In order to keep it in gear with the crown wheel on the roll, a special form of yoke and thrust bearing was designed, which is carried on the projecting end of the vertical roll above the crown wheel. The driving wheel on the horizontal shaft has a long boss or sleeve, on which are formed collars; these fit into and run in the thrust bearing on the top end of the vertical roll. The spindles for driving the horizontal rolls are both supported in bearings, the upper one in a manner similar to that already described for the cogging mill at Wishaw.

At the front and back of the rolls are dead rollers, carried in brass bearings on side frames, and extending a considerable distance from the rolls. At each extremity are special carriages, similar though not ideniical in design, for bringing the ingot to the mill at one end, and removing the slab to the shears at the othe. These carriages were adopted in place of the long series of live rollers commonly used. They are actuated by hydraulic rams, whose stroke is multiplied by the intervention of chains and pulleys. The rams and cylinders are placed on the ground, a little away from the centre line of the mill. The carriage for bringing up the ingot was a necessity under the special circumstances, inasmuch as the crane carrying the ingot is fixed, and can deliver it only at a certain point some distance from the mill. At this point is placed the ingot cradle, now so commonly used, but first designed and used at these works.

At the front and back of the mill, and in line with the roll housing at one side of it, are special appliances for moving the ingots or slabs. These consist of long piston rods, having a piston at about the middle of their length, on which work long pushing cylinders, carrying arms that extend across the centre line of the mill. The arm in front of the mill is made to rotate in a vertical plane upon the pushing cylinder by means of a small hydraulic cylinder and ram, which can take hold of a small projection on the back of the arm, when by the longitudinal movement of the pushing cylinder it is moved out to a certain distance from the rolls. The piston rods are hollow from each side of the piston, and through apertures in them the water pressure is admitted by which the cylinders are moved. The action of the parts is as follows: The ingot carriage is moved up to the cradle, which has received the ingot from the crane. The cradle is turned down, and deposits the ingot on the carriage, which is then moved forward to the end of the mill, the pushing arm having been tilted up for allowing the ingot to pass under it. The arm is then lowered behind the ingot and water pressure is admitted into the pushing cylnder, which moves forward and pushes the ingot over the rollers up to the horizontal rolls of the mill; these seize upon it and pass it through. Then the corresponding pusher on the other side of the mill comes into action, and pushes the ingot back again into the rolls, and this alternate action is continued until the slab is finished to the required width and thickness. All these operations are controlled by one lad at the screwing gear, one man at the pushers and carriages, one man at the mill engines with his assistant to do the necessary oiling, etc., and the roller in charge of the mill. When the slab is finished, the back pusher slides forward, takes hold of the near end of the slab, and pushes it off the rollers and upon the carriage which conveys it to the shears. The carriage is long enough to accommodate long slabs; it is supported and travels on a frame-work of girders, one end of which is pivoted, and the other rests on a hydraulic ram of short stroke, which by raising the end of the girder frame and the carriage resting thereon enables the slab to pass forward through the shear blades without contact with the lower blade until the shearing actually begins.

Hydraulic Slab-shears.—In connection with the first cogging-mill the author adopted hydraulic power for cutting the slabs; and when the second mill just described was constructed shears of the same kind but much more powerful were erected. They were made by Messrs. Tannett Walker & Co., Leeds. On the four corners of a massive bed-plate are placed columns supporting the cast-steel entablature, in which are formed three cylinders, the centre one 31 inches diameter, and the two side ones each 22 inches diameter. Four strong steel bolts, passing through base-plate, columns and entablature, bind the whole together into a firm strong structure. The rams for the two side cylinders are made sufficiently long to extend for some distance into the base-plate; they thus act as guides to the bolster of the upper shear-blade. The bolster is a strong steel casting; its upper centre part forms the ram of the large centre cylinder, while the two side rams pass through and are attached to it by strong tap-bolts or screws. The lower bolster is fixed on the base-plate; for resisting the lateral pressure when shearing, it is supported by two strong steel castings, which are placed on the base-plate under the columns, the main binding bolts passing through them. These castings are also strengthened by a strong bolt fastened through them, transversely to the shears. Provision is made for holding down the after end of the slab during shearing, by a cylinder fixed on the entablature, in which works a ram acting through a cross-head upon two rods; the latter are attached to a second cross-head, which presses down on the slab. All the rams are designed to work against constant pressure from the accumulator, and thus the return stroke is obtained. The accumulator is loaded to give a pressure of 1 ton per square inch. The pipes or tubes are all led to a convenient position, where all the movements are controlled by one man at the valves. On two of the columns brackets are provided, which support sliding brackets carrying the table that receives the slab when sheared. This table has hydraulic cylinders and rams under it, by which it is raised or lowered to suit the stroke of the shears when cutting off the slab. By the action of another ram the table after receiving the sheared slab is made to slide outwards, away from the shear-blade, and into range of the hydraulic crane, which lifts the slab and loads it upon the carriage, where it is weighed and stamped, preparatory to being passed forward to the plate-mill. In shears of this kind, it is important that the cut should be made as rapidly as possible; otherwise the hot slab is so long in contact with the blades that they become softened, the edges fail and they are soon rendered useless. Hence the areas of all apertures leading to the hydraulic cylinders should be as large as possible.

Slab-cutting shears of great power were made by Messrs. Buckton & Co., to work in connection with the cogging-mill at Wishaw steel works. The machine will cut a hot slab up to 42 inches wide and 12 inches thick. It is driven by coupled engines, with cylinders 26 inches diameter and 30 inches stroke, through gearing with a multiplying p wer of thirty to one. The eccentric shaft is 20 inches diameter in the necks; the caps of the eccentric shafts are held down by four bolts of 10½ inches diameter, passing through the uprights from top to bottom. While a slab is being cut off, it is held down on the anvil of the machine by a self-acting hydraulic-pressure foot, giving a load of twenty tons; this prevents the slab from tilting upwards under the action of the cut. The remaining portion of the bloom rests on a roller cradle, which is supported by a hydraulic cylinder loaded to a constant pressure of 20 tons, so that the bloom is upheld and prevented from tilting downwards under the action of the cut. Thus both parts of bloom are compelled to remain approximately horizontal; in consequence the severed ends are cut square, and are not sensibly scarfed. The cradle of live rollers which supports the bloom becomes depressed under the pressure of the shear slide, and recovers its position when the slide goes up again. The cradle is arranged to feed the blooms into the machine, and the cut slabs are delivered over the anvil. The object of this arrangement is that the live rollers which feed the bloom in may be brought as close to the knives as possible. At the delivery side of the machine there is a hydraulic measuring stop, for gauging the cut slabs to measured lengths from 6 inches to 8 feet long. It has a pointer and graduated scale for measuring; and is made with a hydraulic tilting cylinder, to swing the top free above the travelling bloom. With this gauging stop, the bloom can be stopped while travelling on the live rollers, and can also be pushed back into exact position for cutting, and be regulated easily to a fraction of an inch.

Plate Mills.—In this country it is almost the universal practice for plates of, say, ¼-inch thickness and upwards to be rolled in reversing mills, especially if they are of considerable area and weight; the difficulty in handling heavy slabs and plates no doubt conduces to this practice. Whether it is the most economical method of manufacture, especially for what may be described as plates of medium thickness and weight, may, perhaps, be open to discussion; but for handling the heavy plates now produced it is undoubtedly the safest, and, perhaps, also the most economical. The plate mills supplied to the Wishaw works by Messrs. Lamberton & Co. are excellent illustrations of present practice. For general use in producing plates of medium width, the mill is provided with two stands of rolls, the finishing pair being chilled, as is customary. The rolls are 8 feet long and 30 inches diameter. Both top rolls are supported on hydraulic balances, and have a lift of 18 inches. Mechanical screwing-gear is applied to the roughing rolls, and is driven by a pair of small horizontal engines geared to give the required speed. The chilled roll is screwed down by hand in this case; but there is no satisfactory reason why the screwing should not be done mechanically at both rolls. Arrangements exist which admit of accuracy of gauge being obtained with certainty when mechanical screwing is applied to the finishing as well as to the roughing rolls. One simple method which may be mentioned is the insertion of what may be termed a short screw-jack between the chock and screw in one of the housings; a slight alteration of this, made by the roller when necessary, will at once correct any small inaccuracy in the setting or position of the main screws. Live rollers are fitted in the front and at the back of the rolls, and are driven by a pair of vertical engines conveniently placed so that the driver can see the operations at the mill. The live rollers extend a considerable distance in front of the rolls, but only a short distance at the back; here they are supplemented by live rollers fitted into a table, which traverses the two sets of rolls, carrying the slab or plate across from the roughing to the finishing rolls. The table and rollers are actuated by a pair of vertical engines in the usual manner. The table travels in a pit; and its rollers being on a level with the mill floor, the finished plate is rapidly and readily delivered upon it. In a line with this mill is a stand of rolls for handling plates of the greatest weight and width. The rolls are 12 feet long and 40 inches diameter, the top one supported on hydraulic balances. The chocks are all of steel with heavy brasses.

This mill is fitted with mechanical screwing gear, driven by horizontal engines which are fixed on the top of one of the housings; and it is so arranged that either of the screws can be moved alone. Hence, the roller has full control, and can modify the screwing at pleasure, even to the extent of rolling plates of taper cross section if required. The arrangement is as follows:—On the crankshaft of the engine is keyed a pinion, which through a spur wheel drives the main shaft that extends over both housings; and on each of the main screws is a worm wheel, which is driven by a worm on the main shaft. These worms are loose on the shaft, and run in collar bearings in pillow blocks. They have three-pronged clutches on their outer ends, into which can engage corresponding clutches sliding on keys or feathers on the shaft; either or both of the clutches can be thrown in or out of gear, and either of the main screws can thereby be moved or stopped at pleasure by the screwer, who stands on a platform near at hand, and obeys the instructions of the roller. The pinions for driving both mills are placed between them. The spindles for driving the large rolls are of considerable length, so as to reduce the angle at which they drive. They, as well as their coupling boxes, are of steel. In front and at back of this mill are complete sets of live rollers, driven by a pair of vertical engines, which are conveniently placed for driving either these or the live rollers of the 8-feet roughing rolls, as may be required. A useful appliance is here provided for adjusting the position of the plate in front of the rolls so that it shall pass through them as nearly square as possible, and at equal distances from the housings. Such an appliance was first designed by Mr. Duff for the large plate-mill at Blochairn works, but has been modified for use here by Mr. Williamson. A long pusher-bar is connected to a hydraulic ram and cylinder fixed at one side of the live-roller frames; it is moved to and fro across the front of the rolls in grooves between the live rollers; holes are provided in it, into which pegs can be temporarily put, for moving the plate sideways or otherwise adjusting it. These mills are driven by a massive and powerful pair of reversing engines, constructed by Messrs. Duncan Stewart and Co., of Glasgow; they have cylinders 52 inches diameter by 60 inches stroke, and the gearing is in the ratio of two to one.

Three-high Plate Mills.—Although mills of this kind have not been adopted to any great extent in this country, it is known that they are largely employed in America; and in the author's opinion they are worthy of much more consideration than they appear to have received here. When well designed in all parts and details, the three-high mills used in the United States, which have two larger rolls and one smaller, are capable of doing more work in a given time, and probably at less cost, than the reversing mills so commonly used here. The grounds of this opinion are:—Firstly, that for driving three-high mills engines can be used which are highly economical in steam consumption, and if sufficient water can be obtained, they may be of triple-expansion with automatic valve gear; secondly, the mills can be driven at a higher speed; thirdly the loss of time due to reversing can be saved; fourthly, plates can therefore be finished more quickly, and thin plate of large area can be rolled and finished with greater accuracy of gauge and in better condition for testing; fifthly, a larger output is obtained in a given time. These are advantages of considerable importance. The disadvantages are:—Firstly, that the cost of the three-high mill and its tables, &c., is, perhaps, somewhat greater than that of the ordinary reversing mill; and, secondly that the cost of maintenance is slightly greater. But it may be repeated that, if the details were carefully designed, it is doubtful if these disadvantages would exist at all, or, if they did, whether they would be worth much consideration. It is a pleasure to see one of the three-high mills at work, when in good order; and the contrast with an ordinary reversing-mill is somewhat striking. With proper appliances few men are required, and there is little, if any, larger demand on their skill. The use of the three-high mills, however, should be limited to the production of plates of light or medium weight and of medium width.

Steam Plate-shears.—A set of plate-shears recently supplied to Messrs. Colville & Co., Motherwell, by Messrs. Lamberton & Co., which are considered to embody some improvements, are worthy of note. They were designed for cutting plates 2 inches thick at a gap of 37 inches. It was concluded that the ordinary form of cast-iron standard could not be relied upon to resist the strain on the material round the region of so wide a gap; hence the special design was adopted. The standards are formed of several pieces, which are bound firmly together by large steel bolts, 13 inches diameter, passing from top to bottom of the machine. In the act of shearing the whole strain is taken by these bolts, which are considered to be much more reliable than any mass of cast-iron in the form of standards could possibly be. The engines are coupled and reversing, and of sufficient power to start the cut from rest. Rams are also provided for holding the plate firmly down on the bolster during the shearing.

Hydraulic Plate-shears.—Recently doubts have arisen whether steam-driven shears are the most suitable for the heaviest class of work, and consideration has been given to the use of hydraulic power for this purpose. By one of those curious coincidences which not unfrequently occur, two or three minds appear to have conceived simultaneously the application of hydraulic power in almost identical form. In a set of hydraulic shears designed by Mr. Lamberton the same general construction of standard is used as in the steam shears just described. But motion is imparted to the cutting blade through toggle arms attached to a main crank-shaft, whereon are keyed two levers, which in turn are connected to the rams of two hydraulic cylinders. Pressure in a hydraulic cylinder counterbalances the weight of the apron, and ensures the return of the rams in the main cylinders when the valve is open to the exhaust. The special feature in this machine is that by a special arrangement the parallelism of the cutting blade is maintained throughout the whole length of a cut, which may be as long as 12 feet or 15 feet to meet modern requirements. Designs for a hydraulic shearing machine embodying the same principle and in almost identical form have also been recently submitted to the author by Mr. Wicksteed.

A powerful shearing machine which Messrs. Beardmore are having constructed appears also to be on the same lines, but with some novelties in construction which are of interest. It is of massive design, and is capable of shearing mild steel plates up to 2½ inches thick. The cheeks or standards each consist of two steel plates 14 feet by 9½ feet by 6 inches, which are separated by a cast-steel distance piece, so as to stand about 13½ feet apart from centre to centre. The gap is 37 inches wide from the edge of the bolster, and is quite open at both ends of the machine, so that a 2½ inch plate 6 feet broad and of any length can be split from end to end with ease. The motive power is supplied by two cast-steel hydraulic cylinders, 20½ inches internal diameter by 4½ feet stroke, firmly snugged and bolted to the back of the cheeks. The ram of each cylinder is in the form of a trunk piston, to which is secured a mild steel connecting rod. The water, under a pressure of 700 lbs. per square inch acts on an area of 330 square inches on the under side of each ram, while there is a constant back pressure of 700 lb. per square inch on an annular area of 47 square inches on the upper side of the ram, thereby enabling the blade to be lifted when the pressure on the lower side of the ram is relieved. The effective pressure on the lower side of each ram is thus 88½ tons. The hydraulic pressure is transmitted from each ram to the blade or apron through a lever having a mechanical advantage of three to one. Both levers are rigidly keyed to one common shaft, 18 inches diameter and 18 feet long, which passes from end to end of the machine, and is supported by cast-steel brass-lined bearings passing through the cheeks and bolted firmly to them. Any tendency to thrust the blade endwise will be resisted by the torsional rigidity of the main shaft. The total pressure therefore transmitted to the blade at any instant is upwards of 530 tons; and, as the cutting edge has an inclination of 1 in 9, the intensity of pressure per square inch on the section of, say, a 2 inch plate in the process of being sheared, will be approximately 30 tons, which allows an ample margin for friction in the working parts. While the plate is being sheared it is held steadily against the bolster by three small hydraulic cylinders, which together exert a pressure of 10 tons, and are bolted firmly to the front guide of the machine. Arrangements are under consideration whereby a mild-steel plate of any dimensions and of thickness up to 2 inches can be taken from the mill-house floor, sheared on all four edges, and deposited again on the floor, with the aid of only one man and a boy.

It is a question worthy of consideration whether plates of such great thickness should be subjected to shearing. Familiarity with the use of mild steel has removed the nervousness which led in its earlier days to the exercise of great care in its treatment. It is now the axiom that in good work steel plates should not be punched; or, if they be, then rimering must follow to remove the injured portions around the hole. Shearing is detrimental to the edges of plates, especially when the shearing blades are in bad order; and the injury is greater with such thick plates as those under consideration, and should be removed by subsequent planing. These considerations induced the author to hesitate in adopting the shearing process for thick plates, and rather to prefer ripping machines for the purpose, thus avoiding the injury, although at a slightly increased cost.

Hydraulic Forging-press Cylinder.—Hammers, which since the introduction of cogging mills have fallen into desuetude for making steel slabs to be rolled into plates, are also being gradually displaced for other work by the increasing use of hydraulic forging presses; and in connection with the construction of a most powerful press, Messrs. Beardmore have taken a step which it may be of interest to mention. The cylinder is of nickel steel, and is probably the heaviest piece yet cast of this material, certainly in the form of a difficult casting. The weight of the casting with head is 64 tons, and the finished weight of the cylinder will be 42 tons. A test of the actual casting has not yet been made; but a portion of the charge was run into an ingot 23 inches by 18 inches, then cogged down to a billet 5 inches by 7 inches, and from this the following test results were obtained: Tensile strength, 40·1 tons per square inch; elongation in 8 inches length, 20 per cent.; elastic limit, 55·8 per cent. of tensile strength; contraction of area, 43·4 per cent.; and Lloyd's bending test was stood without fracture. This product of Messrs. Beardmore's skill and enterprise is peculiarly interesting to the author, seeing that it confirms his expectation of the service which nickel steel may render to engineering work.

Le Roi Mining and Smelting Co. has declared a dividend of 5 cents per share on the 18th inst. This company has now thoroughly developed the property and it may safely be assumed that dividends will be of frequent occurrence. The Le Roi, as said before, has been thoroughly developed, the company has put in expensive machinery, hoists, air compressors, etc., which are all paid for, and now as the product is nearly 100 tons daily the stockholders are bound to be benefitted. A Sullivan diamond drill to be worked by electricity was recently ordered. This will be used to further prospect the properties owned by the company.

MISCELLANEA

Pumice Stone.—Some interesting details respecting this useful mineral may be found in the report furnished by Mr. Norman Douglas to the Foreign Office. Pumice, as is well known, is of volcanic origin, being a trachytic lava which has been rendered light by the escape of gases when in a molten state. It is found on most of the shores of the Tyrrhenian Sea and elsewhere, but is at present almost exclusively obtained from the little island of Lipari. Most of the volcanoes of Lipari have ejected pumaceous rocks, but the best stone is all the product of one mountain, Monte Chirica, nearly two thousand feet in height, with its two accessory craters. The district in which the pumice is excavated covers an area of three square miles It has been calculated that about one thousand hands are engaged in this industry, six hundred of whom are employed in extracting the mineaal. Pumice is brought to the surface in large blocks or in baskets, and is carried thus either to the neighboring villiage, or to the seashore, to be taken there in boats. The supply is said to be practically inexhaustible. Pumice is used not merely for scouring and cleansing purposes, but also for polishing in numerous trades, hence the fact that the powdered pumice exported exceeds in weight the block pumice. Between twenty and thirty merchants are engaged in the pumice trade in the island. Prices rose considerably about seven years ago, when a syndicate, with a capital of £20,000, rented the municipal pumice lands. The syndicate, however, failed through mismanagement, and, since then, though the good qualities always command a high figure, the general tendency of prices has been to fall.

Prevention of Mine Accidents.

At a meeting of the Federated Institute of Mining and Mechanical Engineers, held at Newcastle, England, a prize paper was read by Mr. Austin Kirkup on the means of preventing accidents in coal mines. Dealing first with explosions in mines, from fire-damp and coal dust, he said that, as far as now known, gas and coal dust were the only agents for producing explosions in mines; and to dilute the one with air and to destroy the other was the only method of rendering them harmless. The most explosive mixture of gas and air was in the proportion of one of gas to 9.4 of air, and the least explosive was one of gas to 15 of air. When more air was added, the mixture became unexplosive, and therefore harmless so far as the presence of lights was concerned. Hence the first requirement of every fiery mine was a sufficient ventilation to dilute and render harmless noxious gases to such an extent that the working places of the shafts, levels, stables, and workings of the mine should be in a fit state for working and passing therein. He laid stress on the necessity of good airways. Many mines were at a disadvantage in this respect. In some cases the shafts were too small, but more often it was the underground roads, more especially the return airways. These roads were not usually intended for haulage and travelling, and were allowed to get into a bad state. The sectional area was in many parts very small. Acute bends were frequent, and where faults were met with, the air in many cases was deflected from an horizontal to a vertical course. In order to ensure good results, the sectional area of the return airways should be equal to that of the intake airways, sharp bends should be avoided as much as possible, the abruptness of faults should be smoothed down, and the air should have as easy and straight a road as possible to the upcast. The accumulation of gas in old workings should be guarded against by a system of thorough inspection; where gas is being evolved in old workings which cannot be ventilated it should not be stopped off; the workings should be placed in connection with the return airways, so that the gas as it is generated may expand into them and be diluted by the current.

With reference to safety lamps, the writer thought that in addition to being examined, they should be tested in coal gas and air before being locked and sent into the mine. Fire-damp detectors he considered useful for ascertaining the proportion of gas present in the main return airways of a fiery mine, more especially when the ventilation is produced by a furnace-fed—as in the majority of cases—by the return air current. An ordinary safety lamp will only detect gas when the proportion of gas in the current is 2 per cent. or more, and when it is remembered that it is unsafe to fire shots in a dusty mine in air containing 2 per cent. of gas, it will be seen that the systematic use of a fire-damp detector in a fiery mine may in many instances reveal hidden dangers. It seems probable that, as fire-damp detectors become better known, they will no longer be regarded as scientific toys, seeing that they give such reliable indications of the state of the return air currents. The writer has already alluded to the property of coal dust, whereby an explosion may be extended far beyond the limits of the gas. It is also an undoubted fact that under certain conditions coal dust mixed with air alone will produce an explosion. These conditions are seldom attained except during the process of shot-firing, although instances are on record of dust taking fire on the screens on the surface. The fiery blast from a shot-hole in the presence of coal dust is increased by the combustion of the dust particles, and where sufficient dust is present to feed the flame a blast of explosive violence is formed which often extends for long distances. When small proportions of gas are present in such dust-laden air, the initiation and extension of an explosion is facilitated.

The commonest cause, almost the only cause of dust explosion, is the occurrence of a blown-out shot. This is generally due to the injudicious choice of a shot-hole, combined with the use of too great a weight of explosive and too short a length of stemming. Blown-out shots should be, as far as possible, prevented, and the sole way of doing so, that occurs to the writer, is to employ only such officials at this work as are thoroughly qualified by experience and intelligence to calculate the correct position of a shot-hole and the weight of explosive necessary to do the desired amount of work. The last point in relation to shot-firing is the use of blasting powder in dusty mines. In many mines its use has been abolished; in many more it should be abolished. It produces a heavy shower of sparks and flame, which are most favorable for the initiation of an explosion. Only such explosives should be used as will give a minimum of flame, and devices for the extinction of flame in shot holes should be more resorted to. There are many more proposals for the prevention of accidents in mines from explosions which the writer might have dealt with, such as the compulsory use of safety lamps in all mines, the abolition of all underground fires, boiler fires, furnace or otherwise, and the abolition of blasting in all mines. For the most part they will not bear criticism, for it goes without saying that before abolishing a useful agent we should find something equally good to put in its place.

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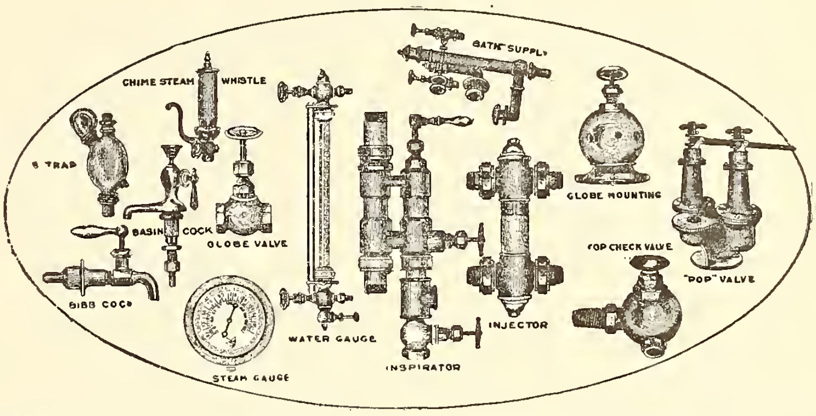

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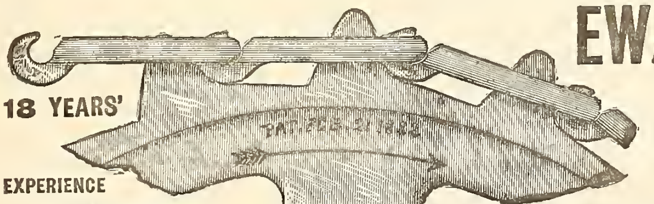

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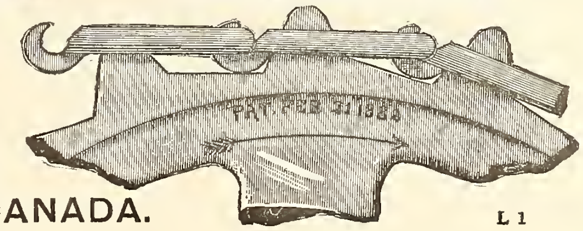

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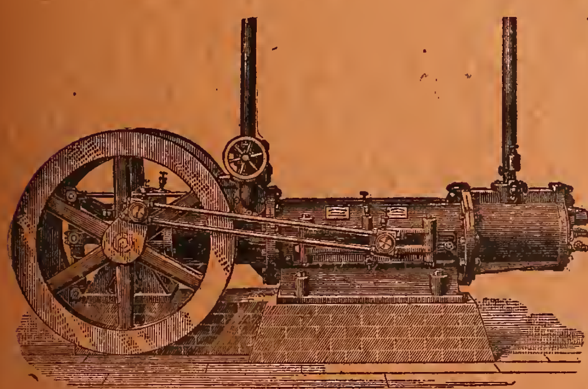

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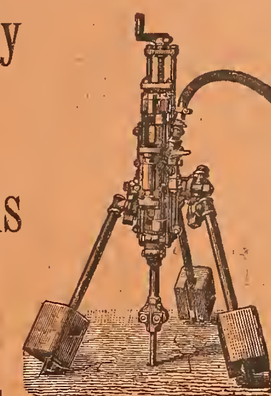

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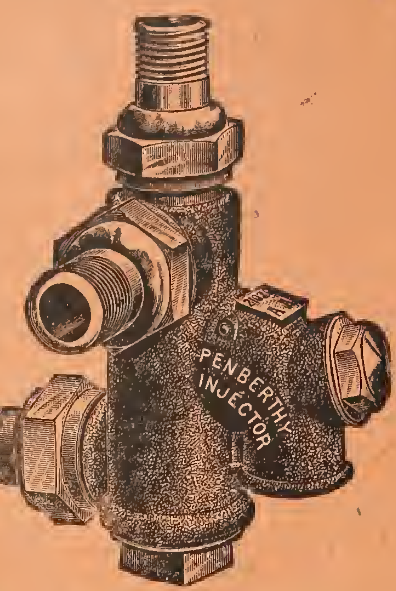

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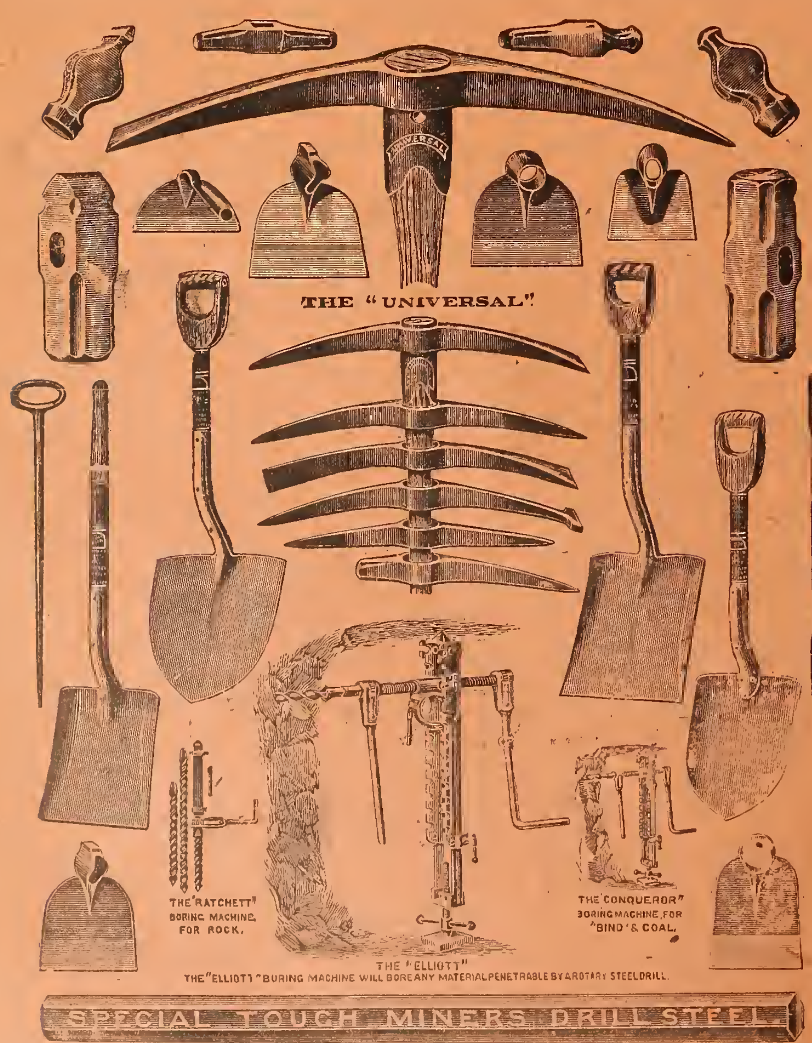

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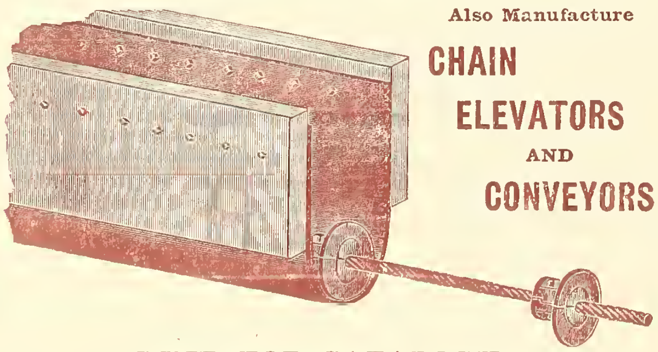

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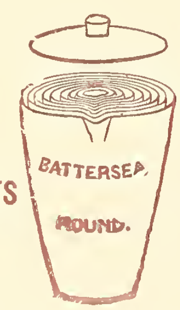

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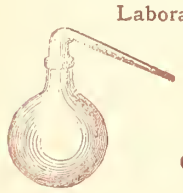

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OTTAWA, ONTARIO.

The Canadian Mining Review
Established 1882

Official Organ of The Mining Society of Nova Scotia; The General Mining Association of the Province of Quebec; The Asbestos Club; and the Representative Exponent of the Mineral Industries of Canada.

B. T. A. BELL, Editor. Published Monthly. OFFICES: Slater Building, Ottawa.

VOL. XIV., No 10 OCTOBER, 1895. VOL. XIV., No. 10

The Lillooet, Fraser River and Cariboo Gold Fields, Ltd. —The Directors Feather Their Nests.

During the early part of the year a company promoted by Mr. F. S. Barnard, M.P., and other British Columbia people, was submitted to the public in a somewhat meagre and crudely drawn up prospectus. This company was styled "The Lilloet (Cariboo) Gold Mine, Ltd," and its authorized capital was placed at £50,000 stg. in £1 shares. The property comprised some 480 acres near the village of Lillooet, Fraser river, known as the Irving, Jensen, Macdonald & Hurley, Robson, and Welton claims, and the purchase consideration was £17,500 in fully paid shares. But little was said of the value of the properties beyond the vague and laudatory puffs of one or two of the parties interested in their disposal, and, as but little development had been done upon them, their worth as producers was entirely left to the imagination of those who might be induced to invest in the enterprise. Since then Mr. Barnard has been to London and has evidently made a full use of his opportunity. The name of the company has been enlarged to the more high-sounding and pretentious "Lillooet, Fraser River and Cariboo Gold Fields, Limited," followed by what can only be described as a hasty and ill-conceived proposal to increase the capital to £300,000 instead of £50,000 as formerly. At a meeting, duly reported elsewhere in our company notes, the shareholders are asked to sanction this remarkable increase in order to alter the company from a "prospecting syndicate into a larger development company." It is singular that the original prospectus made no reference whatever to the company being merely "a prospecting syndicate," but on the contrary clearly described it as being formed to acquire *and develop* the claims already mentioned. The *Saturday Review*, commenting on this effort to obtain additional capital, says:

"The last cable from the company's mining superintendent stated that he had 'sunk to some depth in the bed of the Fraser river and urgently wanted pumping machinery' to keep the water out. That pumping machinery has never been sent; what is the explanation of this? What have the directors done with the original £50,000? They have not produced any accounts and their conduct appears to us most extraordinary. They certainly have not developed the claims, although they may have spent the money. The plain fact is, as the company's mining superintendent tells us, the company's 'gold claims' are waterlogged, and we may infer that the company itself is waterlogged, and (as the existing shareholders are not inclined to subscribe anything more) an indulgent public is now invited to subscribe a further £250,000 for these incapable financiers to squander. And by what means do they seek to obtain that £250,000? Do they go straightforwardly to work and advertise their new issue to the public in the regular way? No; they are securing, in as many papers are honest (? dishonest) enough to encourage such methods, the paid insertion as news matter of the report of the company's meeting on Wednesday last, which report, we may add, consists almost wholly of the speech made by the chairman of the company. That speech is intended to answer the purpose of a prospectus introducing the new issue of capital to the public, and it may serve the purpose admirably, for it contains exaggerated and highly colored statements which never could with safety have been included in a prospectus. It is a one-sided and a glowing forecast of the company's wonderful prospects and vast prospective possessions. Above all, its insertion as news matter in responsible newspapers will lead the unsuspecting readers to suppose that the scheme which it deals with must be of a very sound and important character, for otherwise the various editors would not have devoted so much space to the report of the proceedings. This kind of thing is of course on a par with the shameless system, many times exposed but still going on, of inserting in various papers as *bona fide* news the paid-for puffs of worthless mining enterprises. We are astonished at newspapers and persons of reputation lending themselves to such disreputable practices. Are the gentlemen who at present compose the directorate of the company aware of these facts? or are they, like a great many honorable men, tools in the hands of some unscrulous promoter?"

Referring to the original prospectus we find "The directors are all personally interested in the sale of the property, that is to say, they receive £17,500 in fully paid shares and they pay therefor to the original owners of the claims £9,750, and have also paid in having the mine examined and reported upon some £1,750, so that in consideration of the consolidation of the claims and time and trouble taken in the matter and risk to the money advanced before the formation of the company and satisfactory results obtained, their joint profit receipts are £6,000 in fully paid shares." In this remuneration there was, perhaps, nothing very unreasonable. But Mr. Barnard and his associates, during their visit to London, have evidently become imbued with the atmosphere of "Golden Africa" (which, by the way, is not even gilt), and whereas when the company was formed they professed not to stand in need of any remuneration for their services on the board, at all events, until the shareholders had received a substantial dividend, they now very cooly ask for a minimum salary of £200 per annum each, while Mr. Barnard as managing director is to pocket every year a salary five times as much as the annual increment he derives as a member of the Dominion Parliament.

In a later article, under date of 28th ultimo, the *Saturday Review* says: "We should like to ask Mr. R. M. Horne-Payne, of Sperling & Co., how far his holding (jointly with Mr. F. S. Barnard) of 27,500 out of the total number of 50,000 shares issued by the company helped him to carry the resolutions referred to. These 27,500 shares are part of an original holding of 29,050. They are described as being 'considered as fully paid'; and we shall be glad to learn how much Mr. R. M. Horne-Payne paid for them. It would gratify us to know that he paid for them at the same rate as the 1,600 shares have been paid for which he has unloaded since June last. We have not space to deal *seriatim* with the resolutions which it is proposed to confirm on Thursday next, but the object of these resolutions appears to be an exceedingly drastic 'amendment' of the company's articles of association. Whole clauses are to be cancelled while others are to undergo radical revision. The original shareholders in this company should, before it is too late, very seriously consider these proposals to alter the company's articles of association. Should they finally decide to confirm the resolutions which are said to have been passed at the company's previous meeting, they will place enormous powers in the hands of the present directors, not the least of which will be the authority which these directors are ardently seeking (totally opposed as it is to the spirit of the original prospectus of the company) to vote to themselves 'remunerations' for their 'services' on a perfectly extravagant scale,"

The whole affair bears an unsavory resemblance to that reckless system of company promotion unfortunately too prevalent at the moment in London mining finance, and whose pernicious influence has on more than one occasion wrought havoc with promising mining investments in Canada.

At the moment when considerable interest is being taken in the development of our mineral resources, not only in British Columbia but in the other provinces, many worthless propositions are afoot, and the intending investor must be wary.

The auriferous gravels of British Columbia are beyond peradventure an exceedingly promising field for the investment of that foreign capital which we so earnestly desire, but successful effort can only be realized from judicious capitalization, careful selection of properties, competent management, and the strictest economy in administration..

Gold Mining in Ontario.

The gold field of the Rainy River district, like most other gold camps, in the earlier stages of development, has suffered not a little from the mistaken zeal of its friends. That gold occurs over a widely extended area in the district is now established and that it will be found profitable to mine it at a number of places is also probable, but the widely published statements of the fabulous richness at all points serve no good purpose and really retard its real progress. No one who is capable of forming an intelligent opinion of the value of gold properties will be deceived by these accounts; but men wholly unacquainted with the subject are attracted by them and are induced to squander their money on claims of doubtful value and often to erect mills in advance of any development which would warrant such an expenditure. The inevitable result of such methods is a number of expensive mills shut down for want of ore to work and a consequent withdrawal of public confidence in the gold producing capabilities of the region.

Mr. W. McInnes, of the Geological Survey, who has been investigating the geology of this region, and whose map and report will shortly be issued to the public, was seen on his return the other day and courteously gave the Review the following summary of the occurrence of gold and the mineral development of this section of the country:—

"As far as our knowledge of the geology of the district permits us to judge, the gold is confined to the Keewatin belts, along the entire length of which it occurs at intervals. One belt of these rocks extends from Rainy Lake, with a limited development only on the American side of the international boundary, along the Seine and Atikokan River eastward and beyond the eastern boundary of the district. Besides the main central belt there are a number of spurs and forks extending northward and north-eastward into the Laurentian area.

"All along these belts gold has been found, not always, it is true, in paying quantities, but enough to give good prospects of profitable mining at different points.

"The best veins have been found, up to the present, in the divisions of the Keewatin embracing the quartz porphyric and various altered rocks of like origin. In rocks belonging to this class are situated the mines about Bad Vermillion and Harold Lakes, where mills have been erected, and those on the American side of the international boundary. Similar Keewatin belts in the Manitou region have yielded gold at a number of points, but nowhere has development been carried far enough to warrant the erection of mills in that district.

"The 5-stamp mill at Harold Lake, operated by the Wiley Bros. of Port Arthur, has been working during the latter months of the summer. They are here trying only to save what free gold they can hold on the plates, and are storing the tailings for future treatment. A brick of gold from the mine, with a reported value of about $900.00, was brought out before I left and they were expecting another daily.

"The Sultana, at Lake of the Woods, where they are down about 200 feet, was regularly turning out bricks of gold which would well repay them for their work.

"Most of the other properties were being worked chiefly in the line of development, and, if that policy is adhered to, satisfactory results may be looked for and disastrous failure averted."

EN PASSANT.

The Mining Society of Nova Scotia will hold its next general meeting in the rooms of the Society at Halifax on Thursday, 21st November next. A verbatim report of the proceedings will, as usual, be found in these columns.

The second volume of the proceedings of the General Mining Association of the Province of Quebec will be issued to members next month. The volume contains something over 300 pages of valuable matter respecting the progress of mining in various parts of the Dominion and is profusely illustrated and very handsomely gotten up. Arrangements for the next meeting at Montreal in January are progressing and a good programme is already assured.

That our Geological Survey is thoroughly alive to the necessity of furthering the interests of mineral development has frequently been questioned, the chief complaint being that new fields of discovery were overlooked while prominence was given to territory not at present economically available. Whatever cause for objection may have existed in this regard, certainly none can be made this year, the investigations of Dr. Dawson's field force being very largely directed to mining localities throughout the country at present attracting attention, as a reference to the following will show:

Slocan Silver Districts, B.C.—Mr. R. G. McConnell and Mr. H. Y. Russell.
The Rainy Lake Gold Region—Mr. W. McInnes.
The Iron Resources of Frontenac and Leeds, Ont.—Mr. E. D. Ingall.
The Gold Fields of Nova Scotia—Mr. E. R. Faribault.
The Coal Deposits of Nova Scotia—Mr. Hugh Fletcher.
The Quebec Gold Fields—Mr. R. Chalmers.

In addition to these, and other important surveys, a very notable work is being carried on in the Northwest, where a boring is being put down under an experienced oil-well driller in the tar sands of the Athabasca The ensuing reports of the Survey should therefore be of more than ordinary interest to our readers.

At a meeting of Council of the Ontario Mining Institute, held on 11th instant, arrangements were made for the immediate publication of its first volume of proceedings. Members who have not already done so are requested to return the revised sheets of their contributions to the Secretary as quickly as possible.

Deep sinking in Queensland has apparently not been a success, if we may judge by the following remarks of the Under Secretary for Mines in his report for 1894. He says: "The sum of £10,000 was placed on the loan estimates for the purpose of enabling the minister to grant assistance towards proving auriferous and other metalliferous lodes in deep ground, on such of the goldfields and mineral districts as have made but little or no progress in this direction of late, owing to the inability of unaided private efforts to cope with the magnitude of the undertaking, and more particnlarly so as to open up new channels of lucrative employment to an increased number of miners. In the case of such applications as may be approved by the minister—who may, if he sees fit, call in such advice from geological and mining experts as can throw light on the matter before him—the latter may authorize the payment of a subsidy towards deep sinking, not to exceed an equal sum to be found by the applicant, and on such terms as will amount to a guarantee of the *bona fide* expenditure of the money in such a manner as will most likely lead to the attainment of the desired object. The applicant binds himself to repay the Government the amount of assistance so loaned as soon as the mine is worked at a profit—that is to say, that half the profits obtained shall be paid to the minister until the debt incurred shall be extinguished. I am under the impression that the principle underlying this offer thus to assist in the development of the mining industry is hardly as yet sufficiently understood, for there is evidence that some of the applicants, at least, are under the impression that the intention is to help individuals to develop their properties, instead of, in the first instance, proving that payable lodes exist at depths that have hitherto not been penetrated in the locality. To put it plainly, the object is to assist vertical instead of lateral prospecting. The latter cannot be said to have been a success in any way here, and must be considered to have amounted simply to assist in fossicking, and in no instance has it led to create new openings for profitable occupation for an increased number of men. I trust that the legislature will see fit to provide a sum annually in the future that may be available to assist prospecting our deep ground, and even if the results of the first experiment should perhaps not be quite commensurate with the expenditure, for I am confident that eventually, when the difficulties attached to everything new have been overcome, such assistance will present itself as the most legitimate aid to the mining industry, as it must lead to additional profitable employment to an increased number of miners."

Mr. W. A. Carlyle, M E., lecturer in mining at McGill College, is understood to have declined the position of Government mining engineer offered to him by the Hon. the Minister of Mines for British Columbia. This is an important appointment, and in view of the great progress being made in the mining of the precious metals in that province we trust political influence will not be brought to bear in the interest of any applicant for the position, but that a first class metalliferous engineer with a thoroughly practical experience in mining and milling will be secured. Of course, first-class men cannot be secured for nothing, but the expenditure of a few thousand dollars per annum on a live Mining Inspector will prove in the long run money well invested in the interests of the province.

Just as we go to press, the news reaches us of the clean-up from the Horsefly and Cariboo gold mines, British Columbia, in which Montreal capital is very largely interested. The despatch says: "A cone and bar, weighing in all 3,587 ounces, are at 150 Mile House *en route* for Montreal. The cone contains 2,435 ounces, valued at $41,857, and is the result of a twenty-nine days' run at the Cariboo mine, Quesnel Forks. The bar contains 1,152 ounces, valued at $25,150, from a run of forty days at the Horsefly mine, on Horsefly River." The despatch also reports a strike of rich gravel at the Horsefly, prospecting $8 to the pan. This is, indeed, good news, not wholly unexpected, however, and the returns, large as they are, would doubtless have been much greater but for unforeseen delays and accidents at the mines. We hope to give full particulars in our next issue. In the meantime these returns will be an immense stimulus to the investment of foreign capital now finding its way into British Columbia.

A large deposit of graphite of very superior quality has been discovered on the Madawaska, near Renfrew, Ont. The property has, we understand, been acquired by Mr. T. J. Watters, at a price of $45,000.

CANADIAN COMPANIES.

Lillooet, Fraser River and Cariboo Gold Fields Co., Ltd.

An extraordinary meeting of shareholders was held in London, Eng., on 18th ult. Mr. R. M. Horne-Payne presided, and the other director present was Mr. R. Northall Laurie. Mr. Malcolm Hubbard, the company's solicitor, was also in attendance.

The Secretary (Mr. Edgar Bennett) read the notice convening the meeting.

The Chairman, in the course of his address, said: Gentlemen, you have heard the notice summoning the meeting together, and I regret very much that there are not more directors present today; but the others are residents in British Columbia, and although some of them have been over here recently they had to return—especially Mr. Barnard—in order to look after the company's business. (Hear, hear.) I am aware that many of you have been taken by surprise at being called here today for the purpose of increasing our capital to such a very large extent as that of which we give you notice in the summons to attend the meeting. I am also aware that some of the newspapers have criticised the amount of new capital which we ask you to give us as being out of all proportion to the old capital, and unreasonable in the absence of detailed figures, and moreover unreasonable inasmuch as the new capital required is more than should be prudently expended on properties which we have acquired with the old. I am here today for the purpose of giving you the detailed figures which these dissatisfied shareholders have asked for, and of explaining to you in detail the reasons why your board have considered it desirable to so largely increase the capital; and I feel confident that before I sit down these very shareholders who came here for the purpose of opposing our resolutions will have made up their minds to give us their hearty support. Since the formation of this company your directors have energetically carried out the objects for which the company was formed, and which we described in the prospectus. In the first place we were so fortunate as to secure the services of Mr. D. T. Hughes as mining superintendent. He is a gentleman of great experience, and brings with him the very highest recommendations, and a most successful record from California. Your directors have already experienced the benefit of his excellent judgment, and feel that under his guidance the company's mining operations will be economically and successfully continued. Immediately after the formation of your company, or as soon after as your directors had been able to secure the services of Mr. Hughes and gather together the necessary force of men, operations were commenced on the Lillooet properties, and under Mr. Hughes' direction a very careful survey was made of the property, and how best to introduce the necessary water in the most economical and satisfactory way. Gangs of men were kept working continuously in three shifts a day of eight hours each, but in spite of this energetic investigation, it was thought desirable to make such a very cautious survey of the position before expending your money on the erection of flumes and machinery, so that it was only about six weeks ago that the exact line for the water to be brought on was finally determined. Meantime your company has obtained possession of ali the properties mentioned in the prospectus with the exceptionof one lease, with regard to which, after very careful investigation and the sinking of further shafts, Mr. Hughes reported that the prospects did not warrant the expenditure of capital necessary to work it, but advised, if possible, obtaining from the same vendors certain other properties of theirs in the immediate vicinity, which are found to be more valuable. This has been successfully accomplished; the new properties have been thoroughly and carefully examined, investigated, and proved, and so far promise exceedingly well. From week to week Mr. Hughes reports on both, more and more favorably. The value of these properties was practically ascertained by Mr. Hughes before their acquisition, and his opinion has since been amply justified. Before passing away from the Lillooet properties, I have the pleasure of telling you that on Monday last we received a cablegram from Mr. Hughes, stating that he had now sunk on to an undoubted old channel on the Fraser river, of very great richness in free gold, and had also sunk on to the ancient juncture of the Cayoos creek with the Fraser river, and asking us to immediately authorize the erection of pumping machinery to keep out the water. There is no reason to doubt that Mr. Hughes, who is exceedingly cautious and conservative, truly estimates the nature of this discovery; and, if it is as he states, history will justify the sharholders of this company in congratulating themselves on having one of the most valuable properties of the time. (Hear, hear.) Whilst developing with all possible energy the Lillooet properties your board has also devoted its energies to prospecting and examining claims and mines throughout British Columbia, and has succeeded in securing several very promising properties, which have been developed, assayed and sufficiently proved to amply justify their being worked on a large scale. These properties have been mostly acquired on the principle which your directors have adopted throughout and believe in adhering to—*i.e.*, without the payment of any cash, but by giving the vendors a reasonable interest in the future profits of their respective properties, or, in some cases, paid-up shares in this company. Your directors have selected six of these properties as being the most promising. These properties occupy nearly 1,500 acres." After a brief description, the Chairman continued: "Of course, at this meeting, being an extraordinary one, it is not proposed to submit any detailed accounts, but your directors inform you that of the cash capital of this company, up to the present we have expended in development and research only about £7,000, which has been remitted to British Columbia; otherwise your capital has been lying in London at interest. We are now satisfied that from the result of our investigations we are in a position to invest the money in a way which will be highly remunerative, and with a minimum risk. That British Columbia is one of the very wealthiest portions of the empire is already established; its salmon canneries, which this year will send 480,000 cases, representing practically 5,000,000 of this fish, and a value of half a million sterling, to market, independently of some 300 tons of fresh frozen fish sent to the chief markets of the Eastern United States and Canada; its renowned seal fisheries, its marvellous and unlimited supply of timber, and its great coal-fields, have amply demonstrated this; but your directors are satisfied that British Columbia cannot even be considered as second to South Africa in its gold-producing possibilities. British Columbia forms about one-half of the great mineral belt of America, the southern half of which, situated in the United States, has given to the world during the last half century something like three-quarters, or probably even more, of its total gold supply. A glance at any map of the American continent will show the Rocky Mountain range, which is practically the mineral belt of the American continent, to be about one-half in the United States and one-half in British Columbia and Canada. The gold of British Columbia first commenced to be exploited in 1858, and since then has yielded an output of $500,000 a year, but this has of necessity been merely the result of the efforts of individual miners, working with their hands and such primitive machinery as could be conveyed to the mines on mules' backs for some 400 miles from Vancouver over the world-famed Cariboo road, which might well be described as a wooden bracket nailed on to the precipitous cliffs of the Fraser canon. It is interesting to note that in those days the whole of the transit arrangements of the province were in the hands of Barnard's Express, one of the few enterprises that has ever had the permission of Her

Majesty's government to issue its own postage stamps, and which was founded by your present vice-chairman's father, and practically owned and managed by your vice-chairman from the time that he was twenty years of age until the establishment of the Canadian Pacific Railway. You will, therefore, see that in your vice-chairman and the gentleman whom we ask you to elect to-day as general manager of your company, we have a man of life-long experience, and whose ability to manage a great enterprise has been amply tested and proved. It was not until the year 1888 that the Canadian Pacific Railway drove its way through the heart of this region, and in any way opened up the vast mineral wealth to general enterprise ; but even this was of very limited assistance, and it still left the best-known mining camps at several hundred miles north and south of the road, and it was practically not until last year that, through the opening of the branches of the Canadian Pacific Railway, and the enterprise of the Provincial Government in railway building, the country was opened to any appreciable extent. Immediately several local companies were formed, with local capital, and they have met with considerable success—one or two with enormous success. One mine alone, which twelve months ago changed hands at $75,000, has, within the year, been purchased by a syndicate of United States capitalists for $1,500,000 ; and I see in the local newspapers a rumor that it has now been formed into a company, of which the purchase price is $2,000,000. This looks like a very big jump, but in the case in point I have reason to believe it is one which is amply justified by the output and product of the mine in question. These local companies are only just commencing now to make a regular output, and it was not until the end of this year that, attracted by the success of these preliminary companies, large amounts of United States capital and capital from Eastern Canada were sent into British Columbia for investment. At the present moment a gold boom is raging, miners are rushing into the country in thousands, and the attention of the world is being drawn to the vast mineral wealth of the country that is being brought to light. Our company, fortunately in the field twelve months before the rest, and assisted by the energetic and loyal efforts of its experienced British Columbia directors, has prosecuted its efforts with eminent success, and we believe we have secured some of the most choice properties that have yet been brought to light in this province. We have also every reason to believe that with our organization secured in the capital which we ask you to authorize us to arrange for to-day, assisted by the sympathy of the people, and aided by the support of the legislature of British Columbia, we shall be able to continue the successful exploration and exploitation of this vast field of mineral wealth. Amongst those who have recently issued a report of their investigations of the country, stand forward prominently Dr. G. M. Dawson, Director of the Geological Survey of Canada, and Mr. John B. Hobson, one of the most prominent experts of the west." The chairman gave extracts from reports of these gentlemen as to the richness of British Columbia in minerals, spoke of the opening up of the country by railways, of the great coal mines of the province, of its timber resources, and of the abundance of labor, and proceeded : "The country is also within easy access of Europe—far easier, indeed, than is South Africa, as Europeans can be now comfortably, even luxuriously, transported to the mines in from fifteen to twenty days. If, therefore, South African results have been great and eminently satisfactory, and if their prospects are absolutely apparently unlimited, we still feel that we may safely conclude that the results in British Columbia will be equal to them, for we cannot lose sight of the fact that British Columbia is more than half of the great mineral belt of North America, the southern half of which has already produced an enormous proportion of the world's supply of gold. Before, however, going into such a great enterprise as the development of the mining resources of British Columbia, or even before committing themselves to the large development which your present possessions require, and the expenditure on machinery necessary for the profitable working of them, your directors have felt that they must have sufficient capital at their backs to know that they can carry through this work to a successful issue, and that they have sufficient financial backing to guarantee them large additional capital if the results which they obtain justify them in asking for it. They have, in the scheme which they to-day lay before you, accomplished these ends. They have succeeded in obtaining the guarantee of amply sufficient capital to work your present possessions, and they have also succeeded in obtaining perhaps the strongest financial backing which it is possible to have in all Europe. Amongst the new directors whom we ask you to elect to-day will be seen the names of certainly two of the best known European bankers and financiers. They need no words from me to recommend them to your favorable consideration. The position of the company which Mr. Rosenheim directs, or assists to direct—viz., the Anglo-French Exploration Company—and his equally successful connection with other companies, has proved an ample introduction for his name on the British market. Baron de Machiel's name is sufficiently well known throughout Europe to make it unnecessary for me to refer to him. In Dr. Goldschmidt we have a scientist of the very highest order, and in Mr. Forbes George Vernon, the present representative of the British Columbia Government in this country—to whose zealous and indefatigable efforts as Agent-General we largely owe the fact that we ever came to consider the extension of our enterprise and the development of British Columbian resources, and who was for seven or eight years minister of Public Works in British Columbia—we have one of the very first men of local experience and judgment. But if amongst our new directors we have men of great financial position and name, I can assure you that they are merely types of the gentlemen who have put together their money to subscribe our new capital, and there are many other names on the list of equal celebrity. When your directors had made up their minds that it was for your best interests that we should extend our operations on a large scale, they consulted their brokers in London and in Paris as to how this might best be done, and your brokers organized a syndicate to guarantee new capital, in which they themselves, showing their good faith in the enterprise, have taken a very large share. Your directors have also taken a very large share. I wish particularly to draw your attention to this fact. You will at once realize that it would practically have been impossible to carry through the scheme if your directors had not come forward and shown their confidence in it by putting their hands into their pockets in no mean way, and I may tell you that one of your new directors has subscribed £30,000 of the new capital, another has subscribed £20,000, whilst I myself have induced my firm and friends in this country to put up £40,000. This money has already been paid into the bank. I do not mention this with a desire to advertise the fact, but because there is an option attached to this subscription on the same lines that have already been adopted by the British South African Company, and because we hope that when in twelve months this option matures, by our efforts we shall have made the shares of your company worth perhaps £4 or £5 apiece, and I do not wish you to be able to say then, or even to think then, that we have been guilty of a breach of our trust in making a profit out of the shares of the company. I wish you particularly to note the facts in connection with this matter, and to note them well and for good and all, and I may add that if any shareholder here would like to take part in guaranteeing the subscription of capital it is not too late for him to do so. The syndicate will be managed by your company's Paris financial representatives, the senior member of whose firm is proposed as one of the new directors, and they are prepared to guarantee the subscription of half of the new issue, viz., £100,000, if it should not be subscribed forthwith by the present shareholders, on condition of the syndicate having for one year the option of taking at par the remainder of the new issue. These are practically the same lines already adopted by one or two of the most celebrated and successful South African Companies, and I am confident that the shareholders to-day will feel and agree with me that they are fair and reasonable terms. Owing to the important increase in the business which it is proposed your company should undertake, we feel that we should have a larger directorate, and we therefore ask you to increase the number of directors from five to nine. We also ask you to ratify the action of your board in negotiating with Mr. Frank S. Barnard, M.P., to act as managing director of this company, and take charge of its executive affairs in British Columbia, at a salary of £1,000 per annum. I feel sure that the shareholders will not only not hesitate, but they will congratulate themselves on the opportunity of electing and securing the services of men of such calibre and European reputation as those to whom I have already referred as being proposed as the new directors. I am sure also that the shareholders will feel that it is only just that we, directors, who have hitherto acted for you with no salary or recompense whatever, saving only the large interests which we have in the shares of your company, should ask for some definite remuneration henceforth, considering the fact that we shall now be called upon to give a great deal of our time and our very best services to the direction of a large enterprise. I shall therefore ask you to vote a resolution granting us a minimum salary of £200 each per annum. As this in itself will be a very small recompense for the time and work which we shall be called upon to give to your affairs, we shall ask you to give us, to divide amongst us, 10 per cent. of all the profits we shall make for you after a dividend of 10 per cent. cumulative has been paid on the shares. In conclusion, I may say your directors consider that the company now embraces every element of success, and every element necessary to enable it to become one of the great enterprises of the day. It has a vast field of practically unlimited mineral wealth, the sympathy and support of the province, great railway facilities, ample and cheap water, coal, timber, and labor, an invigorating and good climate, ample capital for its present necessities, and a directorate containing some of the most experienced and successful local men, whilst from the powerful financial connections represented on its board it has the assurance that it will always have ample means at its disposal to continue successfully in operation. Finally, your directors have reason to believe that the legislature of British Columbia, being fully aware of the keen competition of other countries to secure capital for the development of their industries, will recognize the efforts of this company to open up the mineral resources of the province, and extend to it every encouragement and legitimate assistance. I trust, gentlemen, that when the time again comes round to have the pleasure of meeting you, assembled together here, which will be at no very distant date, we shall have got at least two of our mines in first-class working order, and that I shall have the gratification of asking you to vote the payment of a substantial dividend on your shares. I shall now be very happy to answer any questions which any shareholder may wish to put me, and shall then proceed to move and explain the resolutions which we ask you to agree to to-day.

No shareholder desired to ask any question.

The Chairman said—I am glad to see that we appear to be unanimous, and the directors are very gratified by the kind confidence you place in their efforts.

Seven resolutions giving effect to the scheme explained in the chairman's speech were next separately put from the chair, and seconded by Mr. Laurie. Each was carried with unanimity.

Mr. Northall Laurie said he had to report that the Board had received with regret the resignation of Mr. Edgar Robson as a director, and had proceeded to elect Mr. Horne-Payne in his place. Mr. Payne had frequently visited their properties, and therefore spoke with experience and knowledge. It was owing, in a great measure, to his exertions that the powerful syndicate of English and foreign capitalists had been formed to develop their property. (Cheers.) He asked them to confirm the election of Mr. Payne as a director. (Hear, hear.)

Mr. Macaulay seconded the motion, which was cordially agreed to.

The Chairman, in reply, said—I thank you gentlemen, very much indeed for confirming my election, and I shall certainly devote my best attention to the affairs of the company. (Hear, hear.) I also thank you for attending here to-day, and for the confidence you have shown in your directors by the entirely unanimous way in which you have adopted the resolution. (Cheers.)

Mr. Mitchell Innes said they must not separate without passing a vote of thanks to the chairman, which vote he proposed. (Hear, hear.)

Mr. Verner seconded the motion, which was heartily adopted, and a word or two from the chairman closed the proceedings.

Bell's Asbestos Co. Ltd.—An extraordinary general meeting of this company was held last month at the Cannon Street Hotel, London, Eng., Mr. H. Heywood presiding.

The Chairman said the meeting had been called for a very practical purpose, and to put in form the instructions of the shareholders to the directors. The directors were appointed not only to look after the proprietors' interests in the works and the profits and the management, but also for the purpose of enhancing as much as they possibly could the value of their shares and their property, and as it had been suggested to them on several occasions that the existing shares in the company's capital should stand at £1 each instead of £5, they thought it desirable to send out a circular letter to every shareholder, begging that he would express his opinion, "Yea" or "Nay." The replies to that circular were very largely in favor of the reduction being made, fully 80 per cent. of them supporting the change. Of course, acting upon the shareholders' wishes, the directors made the recommendation, but the decision rested with the meeting. It had been urged that there were many small investors who might be induced, if the shares were reduced, to take five or ten at £1 each who would not be satisfied as holders of one or two £5 shares ; and it was hoped that the small shareholders would be large buyers of the goods produced by the company. If that proved to be the case, their prospects would improve very materially. (Applause.)

Mr. Bolling moved : "That each of the existing shares in the company's capital be divided into five shares, so that the capital may be £200,000, divided into 200,000 shares of £1 each.

Mr. Bird seconded, and the resolution was carried.

The Chairman then submitted the draft new regulations of the company. It would doubtless be remembered, he said, that at the last meeting the shareholders were good enough to suggest that the remuneration of the directors should be changed, and that they should receive a somewhat increased allowance. He pointed out that that could not be done without altering the articles, but that the Board would take the question into consideration. They consulted the company's solicitors, who considered it desirable that the articles, which were more or less obsolete, should be brought up to date. The solicitors consulted counsel, and the result was before the shareholders. One of the principal alterations was as to the borrowing powers, so that they might borrow without any question on the part of the lenders. Then it was proposed to eliminate the article that gave them power to issue shares to bearer instead of to a registered owner. It was suggested that the Chairman, instead of receiving £150, should receive £250 per annum as a minimum remuneration. He had from time to time pointed out that, although they had made and were making very large profits, he thought it scarcely wise for those profits to be divided without their having a very large reserve fund. There had always been a great temptation to pay a large dividend, so

GENERAL MINING ASSOCIATION OF QUEBEC.

Group Taken at Quebec, 28th June, 1895.

F. T. Shutt, Ottawa. — George E. Drummond, Montreal. — John J. Penhale, Black Lake. — C. W. Morgan, Toronto. — L. J. Lynch, Quebec.

D. Smith, Brownsburg. — —— — T. W. Gibson, Toronto. — L. A. Klein, Black Lake. — J. Obalski, Quebec. — L. Gendreau, Jersey Mills. — John Blue, Capelton. — Jas. Mitchell, Sherbrooke. — G. Y. Chown, Kingston. — A. W. Stevenson, Montreal. — W. T. Bonner, Montreal. — J. Burley Smith, Glen Almond. — J. T. Dwyer, Montreal. — Prof. Nicol, Kingston. — E. B. Haycock, Ottawa. — R. W. Prittie, Toronto.

—— — —— — Hon. E. J. Flynn, Quebec. — Hon. George Irvine, Q.C., Quebec. — Mrs. Klein. — Mrs. Lynch. — Jas. King, M.L.A., Quebec. — —— — B. T. A. Bell, Ottawa. — R. H. Brown, Sydney, C.B. — Mr. Justice Sedgewick, Ottawa.

—— — Miss Lynch. — —— — ——

the directors' remuneration might be very considerably increased, and in order to avoid that, the clause had been ltered. It was proposed that the directors should be remunerated to some extent according to the profits earned, namely, by a percentage, after 10 per cent. net profits had been earned, that they should set aside a certain amount to reserve, and that their share should be reduced from £200 to £100 for each 1 per cent. paid in excess of 10 per cent. The regulations had been passed by the Stock Exchange Committee.

Mr. Bolling proposed the approval of the draft new regulations, and this was seconded by Mr. Stallybrass.

The resolution was carried, and the regulations were formally declared to be the new regulations of the company.

Nova Scotia Steel Co. Ltd.—The profits of the year ended 30th June, 1895, were $22,578.35; to this must be added the balance of credit of Profit and Loss Account, Nova Scotia Steel and Forge Co. Ltd., 1st July, 1894, $3,886.75; also balance at balance of credit of Profit and Loss Account, New Glasgow Iron, Coal and Railway Co. Ltd., 1st July, 1894, $90,814.59; a total of $117,279.69. The directors recommend that this amount be distributed as follows:—

Reserve for insurance against bad debts	$2,436 22
Reserve for blast furnace renewals	3,361 25
Reserve for general depreciation	20,000 00
	$25,797 47

Leaving a balance to be carried forward to credit of Profit and Loss for the year of $91,482.22. The following is a statement of the assets of the company as given in the accounts:—

Mining properties	$1,173,497 93	
Blast furnace plant	320,477 76	
Railway and rolling stock	201,897 68	
Real estate, plant, &c	580,452 05	
Mining machinery	14,143 32	
		$2,290,468 74
Pig iron, coke, &c	156,618 24	
Scrap steel, scrap iron, &c	42,706 17	
Supplies, furnace sand, fire brick, ores, &c.	11,459 69	
Steel manufactured and partly manufactured	208,166 06	
Coal	1,742 87	
		420,693 03
Ledger accounts		75,776 40
Total		$2,786,938 17

The liabilities are:—

Capital stock, preference	$1,030,000 00	
" ordinary	1,030,000 00	
		$2,060,000 00
Union Bank	407,515 76	
Bills payable	103,964 87	
		511,480 63
Depreciation	107,436 93	
Furnace renewals	3,420 78	
		110,857 71
Reserve for bad debts	13,117 61	
Profit and loss	91,482 22	
		104,599 83
Total		$2,786,938 17

Oxford Gold Mining Co. Ltd.—Messrs. G. J. Partington, C. E. Willis, G. E. Francklyn, Chas. Archibald and W. H. Covert have received letters of incorporation under this designation to operate the Oxford gold mines at Musquodoboit Harbor.

Styne Creek Consolidated Gold Gravels Co. Ltd., has been incorporated in British Columbia with an authorized capital of $250,000, and headquarters at Vancouver, to carry on mining in British Columbia, and particularly to acquire and hold mining leases of the lands known as the Van Winkle Bar, in Yale district, and all the water rights, privileges, &c., held at present by the Van Winkle Consolidated Hydraulic Mining Co. Ltd., and also a mining lease of a claim situated on the right bank of the Fraser river, in Township 15, Range 27, west of the sixth I.M., in British Columbia, and all water rights, privileges and assets held at present by the Styne Creek Gold Mining Co. Ltd. The promoters of the new company are: R. G. Tatlow, Edward Mahon and C. Smith.

Northumberland Stone Co. Ltd., makes application for charter of incorporation under the statutes of New Brunswick. Authorized capital, $10,000, in shares of $10. The directors are: Thos. A. Kinnear, Sackville, N.B.; B. B. Tweed, Sackville, N.B.; W. C. Milner, Sackville, N.B.; Napoleon LeBlanc, Botsford, N.B.; and Foster Pickard, Shediac, N.B. The chief place of business is at Sackville, N.B.

Hall Mines, Ltd.—In an interview, Mr. H. E. Crosdaile, the manager, referring to the operations of this company at the Silver King mine, Toad Mountain, B.C., stated that the tramway for carrying the ore from the mines 4½ miles to the smelter is about completed, the smelter plant is now on the ground and by the beginning of the year smelting operations will begin. The smelting plant will have a capacity of 100 tons a day, and the tramway will bring the ore from the mines at the rate of ten tons an hour. There are 7,000 tons of ore now on the dump and 100 men working at the mines. One great advantage of the ore is that it is self-fluxing. It averages across the whole vein without any sorting, and, taking a very conservative estimate, between 40 and 50 ounces in silver, and 5 per cent. in copper; besides, it runs well in manganese, iron and lime, which will obviate the necessity of other fluxes, with perhaps the exception of a little iron. The product of the smelter will be a medium grade copper matté, running several hundred ounces in silver. Tests of the ore have been made in both Swansea and New Jersey and it has been proved to be practically self-smelting—a most important factor in its economical treatment. Ore bins have been erected at the mine of 5,000 tons capacity and at the lower terminus of the railway of 7,000 tons capacity, so that a supply may always be kept on hand and prevent any delays. A railway siding has also been put in and every care taken to make quick and economical handling of ore, coke and matte. At the mine the vein is being thoroughly tested by means of boring by power drills, which are operated so as to prospect the vein below the present workings. The results are proving quite satisfactory. With the smelter in operation a means will be at hand for the owners of such properties as the Poorman and other gold producing claims in the district to get their ore treated at home, and in that way the development of mining will be directly assisted. A mill will probably be erected in Nelson to concentrate such ores before they are sent to the smelter. Mining development is going ahead very busily in the Nelson district at present.

Byron N. White Company, Ltd.—Tenders have been invited for the necessary plant for the concentrator for the "Slocan Star" mine, but the contract has not yet been awarded. The mill will have a capacity of 150 tons of ore a day, and will be run by a Pelton wheel of 85 horse-power. The water will be flumed from both branches of Sandon creek to insure an abundant supply during the lowest stages. This will require some 3,000 feet of fluming. A gravity tramway, 1,800 feet long, will be put in from the mine to the mill. It is proposed to have the mill running by the 1st of January. There are 26 men working on the "Slocan Star" mine at present, but the winter force will number 50. The output averages from 10 to 12 tons of clean galena ore daily, and about 5 tons of concentrating ore are mined for every ton of clean ore. It is estimated that there are from 15,000 to 20,000 tons of concentrating ore on the dump ready for the concentrator.

Maud Hydraulic Mining Company.—A meeting of shareholders was held at the offices of this company at Vancouver on 26th ulto., "to consider an offer of purchase of the property belonging to the company."

Van Winkle Consolidated Hydraulic Mining Co., Ltd.—A meeting was held at Vancouver on 23rd ulto., to authorize the company to dispose of the whole of its assets to another company, for the purpose of working their claims conjointly with others.

Cariboo Hydraulic Mining Company.—Everything is now going along satisfactorily at the claims of the Cariboo Hydraulic Mining Company. The large ditch is supplying about 2,800 inches of water, and three monitors are being operated for about 18 hours daily. The character of the ground being worked is improving, and should no accident occur the results of the final clean-up this season should be satisfactory to the shareholders.

Montreal Hydraulic Gold Mining Company.—This company is energetically pushing the prospecting of its claim in the Cariboo district, B.C. Water has interfered with the tunnelling to some extent, but means are being taken to overcome this. One tunnel has now been run 1,000 feet and will be driven 200 feet further. Crosscuts will be made on either side. So far the results of the work have shown that the whole of the gravel bears good "pay," some portions of the grounds giving exceptionally good returns. Work in surveying for the ditch and building roads will be continued, while the contracts for the pipes will be let, so that the company may be able to commence actual hydraulic operations next season.

Cariboo Gold Fields, Ltd.—The development of this English company's claims proceeds energetically. The plant and the materials for the pipe-line (which will be about 12,000 feet in length) have reached Ashcroft, and it is expected that by the middle of next season hydraulic work will be commenced. Much interest attaches to this scheme, as it is the first hydraulic claim in the province to be worked by elevators, although we believe the Harper claim on Horsefly creek will be worked in this manner.

Peter's Creek Gold Mining Co., of Cariboo, Ltd.—This company is being promoted by Vancouver people, the authorized capital being stated in the prospectus at $25,000. The object of this company is to take over the lease of 1½ miles of ground on Peter's Creek from the present lessee and to undertake the thorough prospecting of the ground by sinking to bed-rock.

Gold Hill Mining Co., of Ontario, Ltd., is seeking incorporation under Ontario statutes to carry on mining in the counties of Hastings and Addington, in that province. Authorized capital, $250,000, in shares of $50. Head office, Madoc, Ont. Directors, O. R. Sprague, Madoc; B. F. Fellows, J. T. Ferries, G. O. Stohrer and Anna Matilda Stohrer, Syracuse, N.Y.

Patterson Gold and Silver Magnetic Separator Co. Ltd., is being incorporporated in Toronto with an authorized capital of $125,000, in shares of $100, to carry on the business of mining, and to buy and sell machinery. The patent rights it is proposed to acquire, is that of a gold and silver magnetic separator invented by a G. A. Patterson, Denver Col. The directors of the new company are Thomas McCraken, Dr. W. T. Stuart, Toronto; H. H. Powell, R. N. Ball, Woodstock; and G. H. Patterson, Denver, Col., the inventor.

North American Graphite Mining and Manufacturing Co. Ltd.—This company is pushing forward the development of its graphite property in the Township of Buckingham, Ottawa County, Que., and the machinery for the new mill which has been erected is rapidly being got into position.

Regina, Ltd.—The main shaft of this mine in the Lake of the Woods District, Ont., is now down 60 feet, and the air-shaft ten feet. The tunnel has been drifted 90 feet, and the vein shows up well at all points. The average width of the vein has been three and a half feet. It is five feet now at the bottom of the shaft and the ore shows visible free gold. The first level from the main shaft will be started in a few days. The walls of the vein are well defined throughout and the ore milled produced very satisfactory results.

Danville Slate and Asbestos Co., Ltd.—A correspondent writes: "We keep up our production steadily, widening old pits and opening new ones. In addition to this we have put up a new mill building, now nearing completion, which will be better equipped by far than any other of its kind anywhere. The building itself is a most substantial one, 160 ft. long and 60 ft. wide, with large outbuildings for engine and boilers, for stock, etc. We expect to commence work in it in a few weeks. The 100-ft. chimney and extensive factory-building are, of course, the wonder of the neighborhood and people come from a distance to look at it. The slate quarry is now under the able management of Mr. Harry J. Williams, formerly of the Beaver Asbestos Co., Ltd. He has made many changes and has put in new and improved machinery, and we now look forward with every confidence to success. Our output of roofing and school slate is constantly increasing and business is satisfactory. These two enterprises in asbestos and slate are no small matters, and there is always plenty of work on hand with them. We employ now about 450 persons, and Danville and neighborhood reaps a rich harvest."

Le Roi Mining and Smelting Co.—At a meeting of directors of this company held at Spokane, Wash., a dividend was declared of $25,000, or 5 cents per share. Since the company recently put in its fine new plant it has been shipping 3,000 tons per month. It pays for freight charges and treatment $14.50 per ton, but has a contract with Heinze, Breen and others, who are building the 100-ton matteing-plant at Trail Landing, B.C. under which they are to take the ore at the bins after October 1 and treat it for $11 per ton. In view of the near approach of this more advantageous arrangement, the company will not make such extensive shipments to the other smelters for the next two weeks. Most of the ore is now going to the Everett smelter. Two hundred tons have just been shipped to Deadwood, to be used in an experiment with the ores there, and some has also been shipped to Tacoma. The ore is in sharp demand by the smelters because of its heavy percentage of iron. The new machinery works to perfection, and enables the company to double its yield with slightly increased expense. The new 100-ton boiler consumes less than two-thirds as much wood as was consumed by the old 80-ton boiler. Wood sells for $2 a cord, and pine and cedar are chiefly used. Some fir and tamarac are burned, but they have to be brought some distance over mountain roads, while the pine and cedar are taken right from the property of the company.

"The mine is now down 375 feet, and the shaft is going down in ore," said Col. Turner. "We shall continue on down to the 500-foot level." The company has just bought a diamond drill, to be used in prospecting underground. It cost $2,000, and will be run by electricity. It will drill 36 feet in 24 hours and will save a good deal of dead development work. The hotel and boarding-house are lighted by electricity, the company having its own dynamos. Two arc lights are in front of the hotel and there is an electric light in every bunk-room. The purpose is to light the mine also with electricity, and the company will still have enough power and to spare for the diamond drill.

Judge George Turner, who has lately directed the active management of the company's property, resigned from the presidency to take the position of general manager, and his brother, Col. W. W. D. Turner, was elected in his place. Col. Turner is the largest individual stockholder in the company. The dividend will be paid through the Traders' National Bank. "We are not making any promises," said Col. Turner, but we hope to declare a dividend monthly from now on. We have 40,000 tons of ore in sight, and even if all development work were stopped now, we would have enough ore to keep us running for a year with an average output of 100 tons daily."

Nearly four-fifths of the 500,000 shares of the Le Roi are held in Spokane, about 100,000 shares being held in Danville, Ill. The principal owners are George Turner, Col. W. W. D. Turner, Col. I. N. Peyton, W. J. Harris, Col. W. M. Ridpath, D. W. Henley, L. F. Williams and Major Armstrong. Other stockholders are Judge Binkley, Judge Blake, Ed. Sanders and Frank Graves. The Le Roi mine was one of the first locations in the Trail Camp, B.C. Joe Morris and Joe Bourgeois discovered the iron outcroppings of the group that has since become famous, and took samples of the ore to Nelson. The returns were discouragingly low, and they were inclined to drop the discoveries, when they met E. S. Topping, who was running a little store there, and who was favorably impressed with the ore and the accounts the men gave of the ore bodies. Bourgeois and Morris were strapped, and offered Topping his pick of the locations if he would pay the recorder's fees for the other claims. He accepted the offer, went down to Trail Creek, and after looking over the ground selected the Le Roi. A few months later Topping came down to Spokane and was showing some of the ore around the city. He met the Turners, Col. Peyton, Geo. Forster and others, and they liked the appearance of the ore, and after having careful assays made, took a bond for 16-30ths of the mine, the consideration being named at $16,000. Later others were taken in, the bond was bought, 9-16ths more were purchased from Topping, and the property was capitalized at $500,000. That was five or six years ago, and since then, through good times and hard, the owners have kept pegging away—building roads, putting in machinery, doing development work and standing generally the brunt of opening up the now famous Trail Creek district. To date they have taken out and expended $150,000. The ore extracted has just about paid for the mine and all improvements, and yesterday's dividend is what the boys call "velvet." Naturally there was a great deal of good feeling among the owners last night.

The Canadian Electric Forging and Smelting Co., Ltd., has applied for Dominion charter of incorporation with a capital stock of $500,000 in 5,000 shares of $100 each. Directors: George Dexter Burton, Boston, inventor; Wm. John Morrison, electrical agent; James Richard Code, barrister-at-law; and Wm. A. Johnson, electrician, of Toronto, Ont., and Wendell Phillip Hartshorn, of the village of Pennyan, N.Y., capitalist. The objects of the company are the acquisition of patent rights for processes of forging, smelting, heating, cooking and the manufacture of chemicals, by-products, and gases, by electricity; the manufacture and sale or lease of machinery, etc., and construction of necessary water, steam and electrical plants and circuits for such electrical purposes; also the carrying on and operating works for forging, refining, smelting, treating of ores, metals and chemicals, by-products, heating, lighting and cooking by electrical methods; also the acquisition of mining lands and rights and the working of mines; to buy and sell stock in companies organized for electrical and power purposes.

The Credit Forks Mining and Manufacturing Co., Ltd., is applying for Dominion charter of incorporation with an authorized capital of $200,000 in 2,000 shares of $100 each. Directors: Robert Carroll, Toronto, manufacturer; John Benjamin Vick, of Toronto, manufacturer; John Henry McKnight, of Toronto, contractor, and Frederick John Beharriell, of Toronto, accountant. The objects of the company are to purchase and acquire the business and assets of the firm of Carroll & Vick, quarrymen, limeburners and contractors; to purchase, manufacture, sell and deal generally in lime, cement, brick, terra cotta, etc.; to mine, quarry and generally deal in stone of all kinds, at the Credit Forks, in the Province of Ontario. Head office at Toronto, Ont.

Beaver Mouth Hydraulic Co.—On October 1st this company made its second payment on the property in the Cariboo District, B.C., sold to them by F. S. Reynolds, several months ago. Four shafts have been sunk to bed-rock, depth being from 90 to 136 feet.

Bridge River Gold Mining Co., on Horseshoe Bend, Lillooet District, B.C., has 25 men at work making a cut to change the river bed. When the cut is finished the company will have a quarter of a mile of river channel which is known to have rich pay dirt. The cut is being pushed to completion as rapidly as possible.

Kootenay Mining and Smelting Co. Ltd.—The Pilot Bay smelter, in a run of 100 days, has produced over 2,020 tons of silver-lead bullion. Of this 98 per cent. was made from ore from the Blue Bell mine (owned by the company), which also produced all the fluxing iron and lime rock. Between 140 and 200 tons of lead ore are now being taken per day from that mine. The concentrating ore is brought from the mines to the smelter, a distance of ten miles, and concentrated (the concentrating plant having a capacity of 200 tons). After being concentrated, the ore is calcined in roasters and then smelted. The smelter is now turning out 20 tons of base bullion per day. Mr. Roberts, the superintendent of the Blue Bell mine, from which the ore treated by the smelter is chiefly obtained, has got things down to a systematic basis far working. The company's plant is situated at Pilot Bay, on a peninsula nearly it the centre of the east shore of Kootenay lake. It consists of three main buildings: the smelter, the concentrator, and a building which contains the roasting furnaces. These buildings partially enclose a yard in which are situated the bins containing the ores, lime, coke, charcoal, etc. These materials are hauled from the barges, which bring them to the works, up an inclined plane to the top of the concentrator building. From that point they can be carried to any part of the works or to the bins in the yard, as may be required. There is also an elevator by which the concentrates or other material can be raised to any level that is desired. Besides these buildings there are blacksmith and carpenter shops, an assay and business office.

In the concentrator building are two 9 x 15 Blake crushers, four 4-compartment arch jigs, two double column jigs, two double-deck buddle tables and two Frue vanners. The capacity of the concentrator is about 200 tons per day. In the roasting house are four reverberatory furnaces, each 65 x 17 feet, with a capacity of 12 tons each per day. It is probable a mechanical furnace may be added which would practically double the capacity. The smelter at present consists of only one stack. The arrangements, however, will allow for the erection of two more stacks, and there is no doubt, that if the supply of ore will allow of this addition, the enlargement of the works would put the enterprise on a still better footing for successful financial operation. The smelter at present can treat 100 tons of ore per day, with the requisite complement of lime, charcoal and coke, which amount to about 40 tons more. In the first week of operation the output of base bullion averaged about twenty tons per day.

The power to operate the concentrator is supplied by a 150 horse power Corliss engine; an 85 horse power Reder engine works the blowers, while a 30 horse power high speed engine drives the dynamo which supplies the electric light with which all the buildings are lighted.

The ore which is at present being smelted comes from the Blue Bell mine, about 9 miles up the lake from the smelter, and the No. 1 mine at Ainsworth. The bulk of the ore from the Blue Bell mine is first concentrated and the concentrates roasted. No other flux but lime rock is required, as the ore carries a large percentage of iron.

This is certainly the most wonderful property in the West Kootenay district and is remarkable for the immense quantity of ore in sight. The early workings of this property date back 70 years ago when the Hudson Bay Co. had a post in that vicinity. At that time they ran a tunnel into the mountain fully 100 feet for the purpose of extracting the galena which was taken out, melted and made into bullets for the trade with Indians. Not far from the old opening may be seen a slag-pile near where the furnace stood. It was no doubt a very crude affair, but it served the purpose. It was easy mining as the ore through which the tunnel runs is chloride. But little of this old tunnel is now in use, probably not more than 50 feet, but it is of service in the upper workings of the mine. At present it is used for a thoroughfare to take waste material to the dump. The lower cross-cut tunnel is opened on the side of the mountain about forty feet above the lake, and is continued for 1,200 feet and intersects the vein about 800 feet in and at a depth of 175 feet, and cuts across the vein 68 feet. The vein of sulphide ore lies next to the hanging wall, and the carbonates lie on the foot wall, which has not yet been encountered and it is certain they have more than 100 feet. On the surface they are working a large open cut, quarrying the sulphide ore on one side. Each shot will dislodge 50 or 60 tons of mineral. On the other side men are engaged in shoveling the carbonates into wheelbarrows and dumping it into the stopes, from whence it is conveyed into chutes in the lower tunnel where it is loaded into cars and unloaded in the ore bins on the lake, and from thence to the barges. In fact all of the ore in this open cut is handled the same. Fifty feet above the lower tunnel is a large stoping chamber 100 x 68 x 25 feet all sulphide ore. The floor of the stope is solid mineral. In driving the lower tunnel a vein of copper was encountered which at the surface showed only a narrow stringer. At fifteen feet it was one foot in width and at 135 feet it had increased to 6 feet and 8 inches, the ore assaying from 11 to 26 per cent. copper. This will no doubt prove a valuable addition to the property. The company employs 40 men at the mine and this force has no difficulty in getting out 200 tons of ore daily.

An air compressor is now on the ground and it is expected work will be commenced on the vein of copper which will also increase the daily output. A pumping plant will also be put in, all being worked by the same power.

The mine is located about nine miles from Pilot Bay, where the smelter is located. The company keeps two steam tugs constantly at work towing barges loaded with ore from the mine, transporting dry ores from the various mines in the vicinity, hauling rafts loaded with wood, lumber, etc.

The Poorman Gold Mining Company has filed articles of incorporation with the auditor at Spokane last week. While the principal office will be at Spokane, the property of the company is located in British Columbia. The capital stock is $500,000. The incorporators are J. A. Coram, of Lowell, Mass.; C. H. Palmer and C. S. Warren, of Butte, Mont.; Patrick Clark, W. J. C. Wakefield, S. I. Silverman and John A. Finch of Spokane, Wash.

Alamo Mining Co.—At a meeting of the proprietors of this company, held at the concentrator, Three Forks, B.C., last month, a dividend of 7½ per cent., amounting to $35,000, was declared.

Evening Star Mining Co.—This is the name of another Spokane company which has just been incorporated to operate in British Columbia, with an authorized capital of $1,000,000. The officers are: D. M. Drumhille, *President*; F. P. Hogan, *Vice-President*; H. B. Nicholls, *Secretary*, Spokane, Wash.; Dr. Russell, *Treasurer*. The claim to be operated is situated on the north-east side of Monte Cristo hill, in the Trail Creek district, B.C. 27 assays gave an average of $53 in gold. The claim is being opened up.

High Ore Gold Mining and Smelting Co.—The directors of this British Columbia company are: Cyrus Happy, J. H. Griffith, W. G. Estipy, Barry L. Rodgers and D. M. McLeod. Head office: 201 Mohawk Block, Spokane, Wash. Assessment work on the claim has been done. Crown grant applied for, and the necessary buildings erected for permanent work.

Ottawa Hydraulic Mining and Milling Co., Ltd.—The work of opening up this company's hydraulic property has been vigorously proceeded with during the summer. The claim is on the east bank of the Fraser River, between Anderson River and Four Mile Creek, and about the centre of the famous Boston Bar flat, in the district of Vale. Tests of the ground, as far as could be done with amount of water obtainable were:—

96 yards	gave 26½ cents	per cubic yard.
200 "	" 24 "	"
150 "	" 22½ "	"
225 "	" 27 "	"

The directors of the company are: Lt.-Col. Joshua Wright, Capt. M. Neelin Garland, and Fred. W. Valleau. The stock is almost entirely held by Ottawa people. Capital, $250,000. C. M. Black is the engineer in charge of the works.

CORRESPONDENCE.

The Mechanical Separation of Lead-Zinc Sulphides.

SIR,—When one visits the different lead-zinc mining camps and inspects the various mills, and sees often the very crude mode of concentration, it is no wonder that the tailings from such works show still a richness of minerals which people on the European continent would consider hardly possible. But how is this? We always hear and read that "Americans have the best engineers, millmen and machines in the world." But surely any foreign expert visiting such establishments must be forced to the conclusion that the owners of these works had adopted in many cases the most antiquated idea of antediluvian millmen. But the one who is a little more familiar with our "peculiarities" in these things, can explain this somewhat differently. Now I am not going to entertain the readers of the REVIEW with these how's and why's; but I shall ask those interested in this theme: "Is it necessary, is it in all cases an unavoidable evil, to lose so large an amount of minerals in the tailings of our ores?" Very likely some will answer me, "Yes, we are obliged to throw a large amount on the tailings-dump, because a close concentration would not pay us, first, through the intimate mixture of the different components of our ores; second, through the small profit on the ore, besides high wages, a great painstaking in saving everything is not permissible." Now, I might doubt the correctness of both these reasons, because, if I can save 50 or 60 per cent. with one manipulation and with the crude machines in use, I can surely save the other percentage also by the addition of some more and suitable machines." These machines will not cost by far the attendance, interest and maintaining them, that the saved minerals will amount to when the year is over. It is a pity to see such waste. This kind of working is crude, unscientific, and is not creditable to our great industry, because it is not necessary. We have the machines to overcome most of these difficulties. "If you cannot find these machines in your home market, look abroad and see if you find them there."

Now, this advice is directed not only to our mining camps in general, but especially also to our new camps in British Columbia. I would like to draw their attention in time to this subject, so that they may not commence with the same mistakes as were made in some of the older lead-zinc sulphide camps. Because, if once commenced, such errors are difficult to redress without the sacrifice of a large amount of capital.

For instance, there are camps in British Columbia where they have a *low grade* of silver-bearing galena with a large amount of blende and copper and iron pyrites. These mines cannot afford to lose a large amount of their concentrates in the tailings, but they can also not afford to send their high zincous concentrates to the smelters; they have to separate the different components of their ore from one another, not only to save smelting expenses, but also to save freight to the smelters, and to make use of the zinc and copper ores for themselves to pay their milling expenses with these "by-products."

Then again, there are mines which have *rich* argentiferous lead ores with blende and pyrites; also these cannot justify a waste of 10 or more per cent. of their galena, because it means a loss of from $20 to $30 per ton; besides they have to decrease also the bulk of their concentrates for the reason that a number of these mines send their ore long distances into the States for treatment.

An especially close concentration needs those ores which are composed of galena, native silver, argentite, stephanite, ruby silver, etc. Not less so, those which carry not only argentiferous grey copper, but also gold—every per cent. lost means a heavy diminution of profit, which accumulates to a large sum at the end of the year, in many cases sufficient to pay for the milling, and often also for the mining expenses.

Germany possesses a great number of mines producing the same ores as those mentioned above. Now let us pick out one of their concentrating works, and see what loss they experience—that is, what the tailings of the mill assay. I have the official figures of the Himmelfahrt mine works before me; this is a government institution, and is situated near Freiberg, in Saxony. The ore which this mine produces is almost identical with the Ainsworth ore, carrying from 50 to 55 ounces of silver per metric ton (=2,204 lbs). The mill has a capacity of 150 tons a day, and is divided into two parts, so that different ores can be treated at the same time, and the same men attend to both sides. The tailings which leave these works assay: 0.01% silver, no lead, 10% sulphur and 9% zinc; neither would there be a loss in the last named metal, if the Freiberg blende contained not up to 33% iron, having the same specific gravity as the pyrites and also the baryte, which latter is found as gangue matter in some of the workings. Now what we have to consider principally here is the milling result—the low amount of silver lost, the winning of all the galena, and not less so, the separation of the components of the ore, that is, the separation of the galena from the pyrites and these from the blende, whereby the works are enabled to send only the pure galena and pure blende to the reduction works, and not everything mixed together, as we usually do. But why? Because they use different and improved machines for concentrating their ore, and save by this a large amount of money, which enables, and has enabled them now for centuries, to work those small veins to a profit. But let us see now what kind of machines they use in Germany for milling an ore as found in Ainsworth, or any other British Columbia mining camp. They have: 1st. Crushers; 2nd, roller mills; 3rd, different sizes of sieves; 4th, jigs; 5th, classifiers; 6th, concentrating tables, and 7th, buddles. 4, 6 and 7 separate the components of the ore by specific gravity. These machines are brought into market very much improved by the well-known Freid. Krupp Gruson Works in Magdeburg-Buckau, which are also the builders of the machines used in the above-mentioned mill. To show how economically these machines work, I shall quote here the analysis made of the tailings coming from the different machines in the Himmelfahrt mine.

1. From jigs for coarse sands—0.005% silver, nil lead, $\frac{8}{10}$% sulphur, and $\frac{9}{10}$% zinc.
2. From the Bilharz improved jigs for fine sands—0.001% silver, nil% lead, 2% sulphur, and 4% zinc.
3. From the concentrators—0.003% silver, 1% lead, 12% sulphur, and 9% zinc.
4. Slimes in settling pits—0.01% silver, 2% lead, 8% sulphur, and 6% zinc.
5. End tailings leaving the mill with the muddy slimes—0.01% silver, nil% lead, 10% sulphur, and 9% zinc.

How carefully the ore is disintegrated in this mill, that is, the production of fine slimes avoided, is proved by the fact that the slime water leaving the mill has in 35⅓ cubic feet only ½ lb. solid matter. Herein lies to a great extent its success, and the success of every mill where this kind of ore is treated, then only through a careful successive disintegration is it possible to save almost the whole amount of metallic minerals.

Someone might remonstrate against my comparison between the milling practice here and the one in Germany, "because in the latter country labor is cheap, while comparatively costly here, therefore close concentration would not pay here." This is a misconception of the real facts. I will not argue with them on the difference in the purchasing power of the money in these two countries, or on questions of political economy in general. No, the principal difference in this case is the machines, and comparing them with ours here, in regard to saving manual labor, we will see that the advantage rests with the newer German system. I will quote here from a paper* by A. G. Charleton, an authority in ore dressing. He says in comparing the different systems in Europe, and on this northern continent: "If the American losses in dressing be compared with those in Germany, it will be seen that the advantage rests with the system of the latter country." And further, in speaking of the Himmelfahrt mine works: "I would like to refer to the Frieberg works more particularly, because I think they are illustrative of American principles, so to speak, engrafted upon former German practice, presenting a model of economy in costs, as well as economy in saving of mineral to an extent *which has never been achieved before*, an advance which is undoubtedly in the right direction." Indeed, what manual labor has to be done in these works? A hand-picking of the ore before it goes on the machines; further, the carrying away of the mixed and finished products—this also could easily be arranged to be automatic; further, the emptying of the settling pits—and even this work is often done by slime or sand-pumps. Therefore, we see that manual labor can be, and is, limited as far as is practically possible.

I gave in the New York *Engineering and Mining Journal* of Aug. 31st, 1895, together with an article upon the same subject, also a reduced sketch of a mill planned by the F. Krupp Gruson Works for a mine in British Columbia. This mill, with a capacity of 60 to 70 tons per day, will do the same good work as the Himmelfahrt Dressing Works above described, with the difference that it will save also all the blende, because the British Columbia zinc blende is of lighter specific gravity than the Freiberg mineral, and very few mines have baryte to contend with, so far as I know.

In regard to those mines having not only galena and grey copper, but also gold in their ores, some slight changes in the arrangement of the mill have to be made.

In conclusion, I advise our British Columbia miners once more: "Do not hastily buy mills before you have a mine, and when you get a mine and you know your ore thoroughly, buy the best, that is, the most economic machines in the market, and by using them judiciously you will make your mine a success."

F. HILLE, M.E.

PORT ARTHUR, 21st October, 1895.

GOLD MINING IN ONTARIO.

Operations in the Seine and Lake of the Woods Districts.

(From our own Correspondent.)

Since the "Foley Combine" acquired the Ray-Wiegand (additional) lots, AL 75-6, the work of development upon these, and their original purchase, viz., AL 74, has gone on much more vigorously—if not more systematically. Machinery, including air compressor, and two Ingersoll drills, with pumps, hoists, &c., are now in position, and a force of miners at work in both shafts upon full time. No. 1 shaft is down 70 feet, on a comparatively small but exceedingly rich vein; while the No. 2 shaft has attained a depth of 36 feet upon a strongly defined, and, if possible, richer auriferous quartz lode than that of the No. 1. This, the No. 1, is upon the original Ray-Wiegand location, as is also the No. 2 shaft. Both these, and it may be observed, almost all their lodes have a strike of N. west 20° to 25° west, and are consequently nearly parallel, and invariably most pronounced in dip and strike; the dip being nearly vertical. About 95 tons of free milling ore, of splendid grade, may be seen upon the dump of No. 1, while the output of No. 2, with its stronger lode, exceeds that of No. 1 in quantity and value, the latter fact being due to the high percentage of coarse and fine native gold. In addition to the foregoing lodes, there are at least seven others distinctly visible, and upon all of which considerable stripping and testing by shallow pits has been carried out by the original owners and prospectors (Colonel Ray & Co.) Buildings, including officers' quarters, additional sleeping camps, engine house, &c., are now drawing towards completion, and the entire property is at present writing being closely inspected by the new company, most of whom are from Detroit and other mining centres of Michigan.

Next in order of merit, discovery and general interest, comes the estate of Colonel Ray, which, exclusive of his interests in the "Foley claims" referred to, owns and controls the entire area of block K 198 (now sub-divided into five lots), also AL 94, 95, 96, 97, 99 and 100. The sub-divisions referred to are as follows: E 258, E 259, E 260, E 261 and E 262, or nearly 500 acres, which traversed as it is by two series of auriferous lodes, viz: those from the "Hunter group," K 74-5, with their north-easterly strike, and the "Wiegand-Foley" lots, the strike of which is north 20° to 25° west, to say nothing of their being immediately adjacent to and in the same geological formation and horizon, render the conditions most interesting.

During the latter part of September, and early this month, a force of men under the supervision of Colonel Ray did some effective work in producing and stripping the numerous lodes traversing this tract, and obtaining samples of their ores, assays of which, it is needless to observe, gave most satisfactory results.

The "Bill Wiegand Claims."—Immediately east of the Ray and Foley claims, already partially described, comes the now well-known "Bill Wiegand claims," including AL 103, 104, 105 and 106 (all of 40 acres each). Work upon these lots has been carried out in a most intelligent and practical way during the past summer, and only this week discontinued for lack of capital. Here also may be seen the same rich series of auriferous quartz veins, with, in most cases, the same dip and strike as those upon the Ray claims, the exception being in the large lode traversing location AL 103 and 104, which describes a curve around the escarpment of both claims, dipping westward. A very appreciable amount of stripping has been done upon the principal lodes here, the width of which varies from 2 feet 4 inches to 12 feet 3 inches, and from almost all of which good panning, as well as some native silver, both coarse and fine, can be obtained. These, the "Bill Wiegand," lots have been thoroughly inspected by European capitalists with a view to investment, and doubtless will, in the near future, be placed under active development. The present owner, Mr. William Wiegand, of Fort William, remains in charge for the winter.

*Transaction of Federated Institution of Mining Engineers, England.

Harold Lake, upon the head waters of La Seine river, and the upper Seine generally, has lately attracted very considerable attention.

The Wiley-Gibbs mine and mill is doing remarkably good work, as may be proven by reference to their regular output of bullion. An additional battery of 5 stamps will be put in there, and fresh ground opened up shortly. Mr. F. S. Wiley and Superintendent Frank Gibbs are present at the mine.

Explorations.—Some excellent results in prospecting have been accomplished at no great distance from the Harold Lake mine quite lately, the assays of which (by perfectly valuable certificates), ranging from 14 to 34 ounces of gold, with some silver, to the ton of 2,000 lbs.

Calm Lake and Sturgeon Falls.—This long neglected though most interesting section is now receiving well merited attention. Near the Falls, the Everett Mining and Milling Company is doing some surface work in mining and putting up the necessary buildings for winter operations.

The Macdonald claim of "H. P. 167," nearer to Calm Lake and directly upon the proposed line of Rainy River Railway, has been bonded to a developing company, and will, it is anticipated, be at once placed under development, while lower down the stream, at the Bull claims, arrangements are also upon the *tapis* for work. The title to this valuable property has so far been delayed by the "timber limit unsettled claims," and to this unfortunate state of affairs is due much of the delay in opening up this and other equally valuable gold claims along the margin of the upper and lower La Seine. An interest in "the Bull claim" was lately disposed of to Mr. Silas Griffis of St. Catharines, who has secured several other valuable locations in this section. It was the intention of Mr. Griffis to purchase the entire claim, could the owners give him a title. This question of titles will, we trust, soon be settled, as but very little timber of a merchantable class exists upon the land, and this will all be cleared off shortly by the three lumber camps now being established there.

Among the other partially developed locations in the Shoal and Bad Vermillion Lakes section in addition to Ray, Foley and Wiegand (and in the same geological formation, viz., protogin granite), may be mentioned the Hillyer, Kelly-Mosher, the Bartley-Wilson, and, last but not least, the Randolph claims, AL 113-14-15-16—all in the protogin, and all carrying very appreciable quantities of native gold, in well-defined lodes.

English capital, at last, shows a disposition to acquire some of this territory, and, as a matter of fact, the Bartley-Wilson claims are bonded to Mr. Ferguson of London, while other English speculators and capitalists have a keen eye to "Bill Wiegand" *et al.*

The Ottawa Prospecting Co.—under the direction of the brothers Bush and Fred. Winning hold an extensive tract of mineral land which has been prospected and located for Ottawa capitalists, including it is said, Mr. W. A. Allan. This tract embraces a number of claims in the Keewatin series, directly opposite the Foley camp and site of Seine city, upon one of which lots, viz., K 236, some very fine results in gold have been obtained. Although most of these lots are in the Huronian slates so favorable to the existence of gold generally, they have also one or more claims of great pro . ise in the granitic protogines, adjacent to the Ray-Wiegand "Bonanzas", where, possibly active operations under their manager, Mr. Winning, senior, may be carried on during winter months.

Mail Service.—Mail communication with the outer world is of the worst possible kind. It is altogether of the "go-as-you-please" description, and since the premature closing of the *Wiegand* office, no official appointment has been made, nor investigations held touching alleged irregularities, notwithstanding the fact of a series of complaints having been made to the department.

From the foregoing it may be inferred that while we have quite a fair showing of gold, and not a few very promising properties, we have also one or two fully developed grievances, one of which is the total want of an organized, or any regular, system of mail service nearer than Fort Francis, which fact, in view of the growing importance of our mining and other industries, shows an astounding amount of ignorance, or a total lack of interest in La Seine River District.

Mr. Archibald Blue, Director of the Bureau of Mines, who has just returned from an official inspection sends us the following respecting mining in the Lake of the Woods:

Sultana Mine.—The Sultana is now opened to a depth of 200 feet, and an immense body of ore is in sight between the first and second levels. Mr. Caldwell, the owner, is still managing the property, and his ten stamp mill continues to send to the bank at Rat Portage a weekly gold brick varying in value from $1,200 to $2,000. If the capacity of his mill was doubled or trebled it seems likely that the ore supply for it could be found, at least for some time to come.

Dominion Gold Mining and Dredging Co.—The Gold Hill and Black Jaek properties, which were worked two years ago by American capitalists, without experience, have now passed into the hands of a London, England, syndicate, and are expected to yield better results. Mr. Robert H. Ahn, who is well known in Toronto, is local manager of the syndicate. He had fifty men employed at the Gold Hill mine, where three shafts were being put down. The Colorado stamp mill, which the old owners had put in, was being repaired throughout and new machinery added. Mining machinery, such as hoisting drums, air compressors, etc., is also being shipped in to the Gold Hill and Black Jack. The same syndicate has purchased the reduction works at Rat Portage. The old ore-crushers have been torn out and are being replaced by four batteries of five stamps each. When all the improvements are in, this promises to be a first-class mill.

Regina.—Another English company, whose president is General Wilkinson, purchased about a year ago a property on Whitefish Bay, known as the Regina mine, and a well-built ten-stamp mill has been erected there. The formations consist of granite and altered trap, and several veins cross the property from one formation into the other. Mining work has, so far, been undertaken on only one vein, where a shaft has been sunk and a tunnel driven into the granite. It is a fine looking ore, and shows considerable free gold. The mill had been running only three or four days at the time of my visit, but I have since learned that the first week's run gave $1,700 from the plates alone. The works are in charge of Mr. Wm. G. Motley, an English mining engineer of large experience, and the company has been organized with a capital of £130,000.

A number of other locations are being developed, and it is likely that other mills will soon be built. A company, organized by Mr. Wright of Ottawa, is at work on a location 22 miles southwest of Rat Portage, known as the Gold Mountain Mine. It is a bedded vein some 60 feet wide, and numerous assays made by Prof. Donald of Montreal are said to give an average of $12 to $13 per ton. The company is now awaiting Prof. Donald's report upon the property before deciding to erect a mill.

I think that gold mining in this country was never more prosperous than now. It has got past the experimental stage in some localities, especially in Lake of the Woods; and while it is not likely that all prospects will prove of value or that all investments will yield returns, I do not doubt the possibility of making gold mining pay in Ontario. Men, however, must show as much judgment and enterprise who go into gold mining as into any other business.

A Port Arthur correspondent writes: Some excitement was caused lately by the discovery of an auriferous quartz vein in the talcous schists near Jackfish station east of Port Arthur. I have not seen the vein myself, but I have heard from miners who have worked there that it is about 15 feet wide, and traceable for a long distance. I have seen and tested ore from this vein, which was heavily charged with chalcopyrite. It may develop into a good paying low grade ore mine. Some very rich stringers of free gold occur in this vein, but of what extent, or if they will continue towards depth, is still an open question. The mine has all facilities for operation, the railroad, Lake Superior, and also a splendid water-power is close by.

A prospector writing from the Rainy River country says: "I left for Lake Osinawa country on the 13th of August and was out 23 days by the Seine river. It is about 200 miles from Shoal lake. I had a pretty hard trip of it as there are 34 portages to make, some of them 1½ miles long. I took no guide with me other than the map (Lawson's), that I got last Spring and found it better than any Indian one could get here. I left Mr. Haycock and my brother working on K 236 where they did good work. They discovered four new lodes, three of which pan very well and are well worth sinking on.

Since I was away Mr. Foley has commenced working on the claim adjoining 231 K that he bought from the Wiegand Bros. last winter. (He paid $42,000 for 80 acres). He has 35 men and 4 steam drills at work. He is sinking on a lead that was 18 inches on the surface. He is down now about 40 feet and the lead has widened to 3 feet and is still gaining. He is putting on more men ever day. The Hillyer mine also is going to start up again as soon as matters can be fixed up. Mr. Hillyer was here a few days ago with a party that intend going in with him. They started the mill, ran 7½ hours and cleaned up from the plates alone 6¼ ounces of gold. There was a party up from Rat Portage while I was away, who made an offer of $15,000 for any location near Hillyer's location, the terms $3,000 down and the balance in 4 months, provided he would be allowed to sink 100 feet and to drop out should he not want the claim after testing the lead, also that the location should show at least two leads not less than 3 feet wide.

While up the river I met a Mr. Wiley who is working the mine of Lake Harold. He was going out to Fort William and was taking the first gold brick from the mine. It was the result of a five days run and was worth $800.00. The lead he is working on is only 35 inches wide. There are a good many men with money coming in now and the prospects are a great deal better than they were a few weeks ago."

The Geological Survey of Canada has just issued a very fine geological map of the Seine River district, Ont., on the scale of four miles to the inch. The map, like that of Lawson's on the Rainy River region, is a very fine piece of work and is just what is required by the large number of prospectors, miners and capitalists interested in the gold and other minerals of that new section of our country. A report on the geological and mineralogical features of the new field, by Mr. W. McInness, who has just returned from the field, will follow at an early date.

We learn that the old Deloro mine at Marmora, Hastings county, has been leased and will be worked.

LEGAL.

Judgment in the Watters—Powell Mica Suit.

Judgment was given this month in the Superior Court, Hull, in the suit of Mr. T. J. Watters, of the Lake Girard Mica Mining System against Mr. W. F. Powell, of Clemow & Powell, mica miners, for the ownership of valuable mining rights on lot 7 of the 10 range of Hull Township, County of Ottawa, Que.

The properties was originally owned by Maurice Foley, a farmer, who purchased them from the Crown, and were in '72 leased by him subject to a yearly rental and a royalty, for 99 years, to the late T. P French, Inspector of Post Offices. Mr. Watters purchased the rights under this lease from the heirs of Mr. French. Mr. Powell acquired his assumed rights from Mr. Pierce Mansfield, of New Edinburgh, who claimed to own the mining rights in question by virtue of a lease of the same given in '74 by Michael Foley, the son of Maurice Foley.

Previous to the commencement of the suit Mr. Powell had begun work on the mica deposit known to exist on the lot, and had extracted several thousand dollars worth of mineral during the three or four weeks before he was disturbed. At the end of that time the mica was seized by Mr. Watters and has since remained in charge of the guardian. The first issue was entered upon in 1893, and during that time the ground has heen contested inch by inch, several interlocutary appeals have been disposed of. In rendering his verdict the judge said that the defendant had acted in bad faith in taking legal possession of this property and refusing to deliver it up. The plea raised the question of prescription, the defendant claiming that he, Pierce Mansfield and Michael Foley, were the owners of the property by reason of their possession. His Honor stated that there was no evidence in the record to justify this pretension of the defence, and consequently dismissed the plea.

The plea regarding the validity of the title deed under which French held the mineral rights was the most important. This deed had been executed by the late Morris Foley and been witnessed by one witness only. Morris Foley did not know how to sign his name and signed the deed with his mark, which was a cross.

This plea raised this very importent question, as to whether the purchase was good in Lower Canada since the deed was signed with his cross, in the presence of one witness only. This point had been very thoroughly argued at the hearing of the case and numerous authorities had been sent to His Honor.

His Honor considered that Foley's mark was valid and dismissed the plea.

The substance of the judgment is that Mr. Watters gets the mica mine from which considerable mica has already been extracted and also the mica which has been extracted therefrom, which is valued at between seven and eight thousand dollars, and the defendant is condemned to pay the costs. Mr. Watters is ordered to pay Mr. Powell six hundred dollars to cover the costs which had been incurred by him in extracting the mica awarded to Mr. Watters. Mr. Henry Aylen, Q. C., conducted the case for Mr. Watters, and Mr. J. R. Fleming, Q. C., for Mr. Powell.

How Gold Occurs in Nature.*

By W. Nichols, S. B.

I cannot during a single lecture treat the subject at all in detail. I can only give you the general principals.

Although gold occurs nowhere in abundance, and although it occurs infrequently in sufficient quantities to pay for mining, yet it occurs in minute portions in all rock. It has not been shown to occur thus everywhere, but its presence has been indicated in so many places as to render such an inference legitimate. The city of Philadelphia is built upon clays which contain more gold than would pay for rebuilding the entire city, nevertheless this clay is more valuable for bricks than for the gold it contains. Around Boston there are places where it is said that a man might earn twenty-five cents a day washing the gravels for gold. Gold occurs even in the sea, which contains something less than one grain of gold to the ton of sea water. Many devices have been invented for the purpose of obtaining this gold from sea water, but none have proved practicable, and it is not probable that any ever will prove practicable. These occurrences do not constitute ores of gold, for the metal is in too small quantities. An ore of gold must contain sufficient metal to pay the cost of extraction. This gold disseminated through the rocks does sometimes occur in paying quantities, and then we have a true gold ore. Such ores occur in some of the Southern States and elsewhere. Some of the deposits of the Black Hills of Dakota are of this class. In these ores the gold usually is in invisible particles, so that in appearance the ore is merely a common slate sandstone or other rock. The gold is concentrated from this state of dissemination into ore deposits by natural agencies which are always acting. These ore deposits are of three classes:—First, associated with silver, copper or lead, in deposits which are primarily worked for these latter metals; second, in quartz veins; third, in gravels which are derived from these quartz veins, the placer deposits. The first class should studied as deposits of copper, silver, or lead, although very considerable amounts of gold are obtained from them. We will not discuss them here.

The quartz veins. I cannot give you a definition of a vein, for geologists are not agreed upon this point.

The gold bearing veins are fissure veins. A fissure vein is a rent or fissure in the surface of the earth, often extending to very great depths, which has become filled with minerals deposited from solution in water.

Sometimes the fissure reaches a region of fused rock, or rock kept from fusion only by the weight of the overlying mass. The fissure then fills with the molten material, which cools therein. This is not a vein, for in a vein the minerals are deposited from water, but a dyke. These dykes never contain ores of gold. More often the fissure does not reach such molten material, and fills with minerals deposited from water. It is then a vein. Very many minerals occur in veins. Fortunately gold bearing veins are quite simple. Two minerals form almost the whole of their contents. These are quartz and pyrite. Quartz is a hard, white, brittle mineral and is the chief constituent of the veins. The other common mineral is pyrite, which may or may not be present. It is brittle, bright yellow, and always occurs as crystals. It is often mistaken by the inexperienced for gold, hence its nick-name "fool's gold." The difference is very great. The pyrite is so hard that it can scarcely be scratched by the knife, not at all unless the knife be a good one, while gold is very soft. It occurs in peculiar crystal shapes, which gold does not assume. It crumbles to a dark powder under the hammer; gold flattens into plates. The gold occurs disseminated throughout the quartz and pyrites, usually in invisible particles, scales, grains, threads, etc. Other minerals are often present in smaller quantities.

The origin of fissures was discussed by Prof. Salisbury in our last lecture. We will now consider how the minerals get into them. They are carried, as I have already said, in solution in water and deposited there. It sounds improbable, but there is nothing that water will not dissolve, though often in excessively minute quantities. When the water is highly heated and subjected to great pressure its solvent power is vastly increased. It then decomposes or dissolves readily many substances upon which its action when cold is imperceptible. Water falling upon the surface of the earth, as rain, or flowing over the streams or resting in depressions, as ponds or lakes, soaks into the ground and reaches great depths, where it becomes very highly heated by the internal heat of the earth, and at the same time it is subjected to great pressure from the weight of the overlying rocks. In this state water decomposes or alters many of the rocks through which it passes and takes many substances into solution. Hot, under great pressure, and loaded with chemicals that it has extracted from the rocks along its path, it takes into solution the substances which we find later in the veins. Reaching a fissure, the water rises through it and as it rises it reaches cooler regions and regions of less pressure; here, no longer able to hold the quartz, gold and other minerals in solution, it deposits them upon the walls of the fissure, the water often issuing at the surface as a mineral spring. Thus the vein is formed.

In some places, as in the Southern States, there occurs another kind of gold-bearing vein. In this case the waters have percolated through porous parts of the rock, depositing minerals in the interstices between the particles of rock—perhaps dissolving some of the "country rock" to make room for the "vein stuff." These veins are often not included between distinct walls, as is the case with fissure veins, and the minerals are not in so pure a state, but for our purposes we need make no further distinction between them.

Veins are divided into two parts by the "water level," a fact of the greatest importance to the miner. The water level is the upper surface of the water standing in the ground. This is shown by the height at which water stands in wells. Below the water level the quartz is usually firm and compact. The pyrite when present is bright and unaltered. The gold is largely—not completely—in the pyrite, and so completely enclosed that no amount of pulverizing will free all of it so that it may be saved by the ordinary process of milling. The gold is not chemically combined, but disseminated in very fine threads, scales, crystals, etc., which may be seen when the pyrite is destroyed by acids.

Above the water level the air has access, and the vein is more or less decomposed, The pyrite is a combination of iron and sulphur; the iron rusts exactly as metallic iron would, and the yellow or brown rust, known to geologists as limonite, stains the quartz yellow.

The sulphur also burns and goes away in solution. The quartz becomes honeycombed with cavities where the pyrite and other minerals have been removed. The gold remains behind as small particles enclosed in the quartz and in the cavities. It is much more easily extracted from this weathered vein than from the unaltered portions below.

Indications of richness of veins are very uncertain. The only one at all sure is an assay. As I have said, gold occurs chiefly associated with quartz and pyrite. The pyrite may be absent. In rich veins the quartz is apt to be discoloured and mixed with many impurities. The greasy appearing quartz is more likely to be rich than others, and a peculiar banded appearance may also indicate richness. A pure, hard quartz is likely to be pure. These indications are of very little value, as exceptions are extremely numerous. Pyrite which is fine grained is apt to be richer than the coarsely crystalline. When gold occurs in grains visible to the naked eye ("specimen gold") it may be taken as evidence that the vein is probably poor, although such veins at times prove very rich. Very little dependence can be placed upon these indications. More reliable information may be obtained from the position of veins. These veins occur almost exclusively in mountainous regions, because the forces by which they are formed, the forces originating fissures and those causing the circulation of underground waters, are more active here than elsewhere. There is no great mountain system in the world in which ores of gold do not occur. I do not mean that gold occurs in every mountain or in every range of mountains, but somewhere in every system.

Veins occur in systems, each vein parallel to the others. If one vein of a system is rich, the parallel ones are probably rich also; while veins of a different system intersecting these would probably be different in contents and perhaps poor. If the contents of both systems are the same, and both are rich, then where two cross the vein stuff will be richer than either alone. The nature of the surrounding rock influences the deposits in the vein. Where a vein passes through two rocks, say slate and granite, it may be rich in the slate and poor in the granite, or vise versa. The deposits of ore in the veins is very irregular. It occurs often only in particular parts of the vein, or in "pockets," or in "chimneys," or "chutes," which run through the vein in various ways. Gold occurs in all geological formations. It is not confined chiefly to any one age. as was formerly supposed. It occurs among rocks of many kinds. One is struck, however, by the frequency with which valuable deposits occur between walls of slate.

The placer deposits are formed from the destruction of the veins, and are never found far from them. At the surface veins, in common with all rocks, are subject to disintegration. By the action of heat and cold, of frost and rain, and in general by exposure to the weather, the rock is broken into small angular fragments, forming sand and gravel. This sand and gravel is washed down the hill-side by rains and streams, and thus the deposits of gravel in the valleys are formed. When these gravels contain the debris from gold-bearing veins they themselves must be gold-bearing and constitute the placers. The gold in the placers is more concentrated often than in the veins because of the sorting power of the water, by which the heavy gold is left near its source, or dropped wherever the current slackens, while the lighter gravels are carried further along. The rich placers in the streams or in gravels left where streams formerly flowed may be worked, and the poorer gravels be left. These are the shallow placers. An interesting modification of the gravel deposits is the deep-seated placer. Placer deposits were formed in times long past in stream beds. After they were formed, a great volcanic eruption occurred and great streams of lava reached the valleys and filled them, completely destroying the streams or turning then into new channels. Since then the disintegration of the rock and the consequent degradation of the surface has continued, but the hard lava has resisted this process until what were the hills have been worn to valleys, and the valleys, protected by their lava caps, have become hills. These are now mined by tunnelling into the gravel from the side of the hill.

We find the gold at first in the rocks, thinly disseminated. and in the sea. Thence it is concentrated into the great veins. By the destruction of the veins it is further concentrated and put in more available form in the placers. From the placers some reach the sea again and is deposited among the rocks now forming, whence at some future time it may again be transferred to veins and placers, for the forces by which these things were done in the past are yet acting and will continue active.

*Digest of Lecture delivered at Field's Columbian Museum, Chicago.

The Equipment of Mining and Metallurgical Laboratories.

By H. O. Hofman,*

Associate Professor of Mining and Metallurgy in the Massachusetts Institute of Technology, Boston, Mass.

The mining and metallurgical laboratory, as we understand the term in this country, is a place in which mechanical and chemical working tests are made on ores, fuels and furnace materials. It is of quite recent origin. The first laboratory of this kind to be used in connection with teaching was put into operation in 1871 at the Massachusetts Institute of Technology.† The idea had already existed in the mind of President W. B. Rogers when he wrote, in 1864, his pamphlet on "The Scope and Plan of the School of Industrial Science of the Massachusetts Institute of Technology;" but several years elapsed, and an extended visit to the mines and mills of Colorado, Utah, Nevada and California was required before this idea could take a form adapted to the purposes of original research as well as of instruction. The laboratory was given from the first into the charge of Prof. R. H. Richards, who, by improving its methods and enlarging its scope, has brought it to the position which it occupies to-day as the leading representative of its class. Private laboratories for making tests upon ores had previously existed here and there, especially on the Pacific coast, for silver and gold ores; but in the educational field the Massachusetts Institute of Technology was the pioneer. To-day there is hardly a school of mines in this country that has not a more or less complete mining and metallurgical laboratory. In European mining schools there is very little laboratory teaching. Most of them are located in mining districts, where the students can personally see and engage in the practical work of mining, concentrating and smelting. Those which are in large cities, at a distance from mines, labor under a great disadvantage. The student only sees practical work when he makes an occasional visit to mining regions, and is otherwise left entirely to theory. It must not be inferred, however, that the location of a school in a mining district can make the laboratory superfluous. On the contrary, one who, like the present writer, has received his training in such a school, sees clearly afterwards, how one-sided becomes the teaching in a mining district without the addition of such laboratory work. The instructor is only too liable to give most, if not all, of his time to elaborating unnecessary details of the local methods, past as well as present, and to pass over with amazing celerity those branches of the subject not represented in his district. Yet even as regards local work, upon which he puts such undue stress, he is likely to be too theoretical, because, not being practically engaged in it, or able to apply such tests as are furnished in the laboratory, he necessarily falls into too abstract a way of viewing the whole subject. The result is that his instruction tends to produce theorists, who speak with unwarranted assurance concerning the most difficult problems which the engineer has to solve; but who, if confronted with a simple, concrete question, are at a loss what to do.

That this lack of laboratory training in German technical schools (which are among the foremost in Europe) is beginning to be realized as a defect was evidenced by the intense interest and careful study bestowed upon the subject by the commissioners who came to the Columbian Exposition two years ago. They did not hesitate

*Trans. Am. Inst. of Mining Engineers, 1895.

†R. H. Richards, *Trans.*, i., 400.

to praise our system and to express the hope that it might be adapted to meet their necessities on the other side of the Atlantic.

The mining and metallurgical laboratory, then, as developed in this country, may be considered a necessary adjunct to every school of mining engineering. In it the lecture-instruction is illustrated with practical experiments, carried out by the students themselves. But it has also a larger scope. By the method of experiment, the student learns how to take hold of each problem as it presents itself and carry it through the different stages until it is, or the reason is discovered why it cannot be, satisfactorily solved. He is thus taught to observe closely, to make careful notes, to compare the results obtained and draw his own inferences and conclusions, and, finally, to report what he has done in clear and accurate language.

In fitting up a laboratory, we have to consider only the departments of mechanical concentration and metallurgy. Practical mining can be taught only in the mine. Some schools (for instance, the one at Ballarat, Victoria, Australia) are provided with a model of full natural size, showing a shaft with the lode, cross-cuts, etc. While this, apart from the question of expense, is an improvement on the small models formerly so extensively found at schools, it cannot but give a false impression of what a mine really is. The practical study of mining, in this country at least, is carried on to-day in "summer schools." The students spend some time in mines, going systematically through the different kinds of work, and thus becoming sufficiently familiar with mine-operations to listen understandingly to lectures on the subject. It is the merit of Prof. H. S. Munroe, of Columbia College, to have given to the summer school of mining such an impetus that to-day there is hardly an American mining school without this auxiliary course.

Before discussing in detail the equipment of a laboratory, it is desirable to consider the relation which the laboratory plant should bear, as regards general arrangement and the kind and size of apparatus, to the large scale working plant of actual practice. A commercial concentrating works, for example, must treat daily a considerable quantity of ore, and must work cheaply, which can only be done if the machines are so connected with one another that the ore shall receive a minimum amount of handling after the work is once under way. In the laboratory, on the other hand, the work, being purely experimental, must be carried on, step by step, in a deliberate and tentative way ; and it is therefore essential that the operator shall be able to inspect the material under treatment before and after every operation. Consequently, the machines must be separate, that they may be easily accessible for starting, stopping, accelerating and retarding, and may be connected at will; in short, that the work may be modified indefinitely under the immediate eye of the experimenter. A laboratory in which this principle is neglected carries in it the germ of failure. The writer was once connected with such an establishment, in which a full-sized ore dressing plant had been erected according to the plan followed in commercial work, viz., the crushed ore was raised by a bucket elevator to a set of screens placed in a line step-wise, one discharging into the other, and the sized products falling directly upon the jigs and the table below. Of course, a few tons of ore were quickly disposed of ; but when the products obtained were examined after the experiment, the observer did not know very much more than he had known before. Such a working plant may be of some value for obtaining more accurate quantitative results after all the necessary details have been determined by the use of detached machines ; but it will do little more than substantiate what has already been sufficiently proven.

There are two opposite views concerning the kind and size of machinery proper for laboratory use. One holds that it should follow as closely as possible that of a working plant. The other maintains the superiority of somewhat different and smaller apparatus as better suited to experimental purposes and also more economical. Having tried both kinds, the writer decidedly prefers the latter, especially for educational purposes, and is of the opinion that there are few mechanical questions to which a machine smaller than the commercial size cannot give a satisfactory answer. In addition to economy, convenience and other considerations, the saving of physical strain upon the student secured by the smaller apparatus is of importance. Fatiguing operations, especially for those unaccustomed to the work, exhaust the powers and unfit the student for mental effort.

The best size for the single machine can only be arrived at by repeated trials, which have now been made for almost all given cases, as will be shown later on.

In the discussion of the details of a laboratory, it will be more profitable to start from the basis of an actual working laboratory, whatever may be its defects, than from an imaginary perfect one. The laboratories of the Massachusetts Institute of Technology, shown in plan in Fig. 1, may well serve this purpose.

The following are the different rooms, pieces of apparatus, etc., referred to by numbers in Fig. 1. In the present paper numbers enclosed in brackets are to be understood as referring to this figure.

1. Milling-room.
2. Blake Challenge rock-breaker.
3. Cornish rolls.
4. Gates rock-breaker.
5. Hendrie-Bolthoff sample-grinder.
6. Iron sampling-floor.
7. Cornish feeder.
8. Automatic feed-trough.
9. Richards' *Spitzlutte*.
10. Coarse Collom jig.
11. Fine Collom jig.
12. Convex continuous round table.
13. Hendy Improved Challenge ore-feeder.
14. Stamp-battery.
15. Amalgamated plates.
16. Frue vanner.
17. Richards' movable sieve jig.
18. Water-tanks.
19. Steam-drying tables.
20. Bucking plates and Taylor hand-crusher.
21. Sampling-table.
22. Ore-bins.
23. Pounding-block.
24. Upright engine.

24.1. Morrel agate mortars.

25. Dynamo, 50 V by 50 A.
26. Dynamo, 2 V by 50 A.

26.1. Revolving barrel.

27. Depositing-table.
28. Leaching-tubs.
29. Larger amalgamating-pans.
30. Small amalgamating-pans.
31. Settler.
32. Tank.
33. Space to grow in.
34. Store-room.
35. Blacksmith's drilling machine.
36. Carpenter's bench.

36.1. Ball-mill.

37. Assay-room.
38. Students' desks.
39. Pulp-balances.
40. Muffle-furnaces.
41. Crucible-furnaces.
42. Stack.
43. Iron table.
44. Balance-room.
45. Button-balances.
46. Store-room.
47. Store-room.
48. Furnace-room.
49. Blacksmith's forge.
50. Anvil.
51. Blacksmith's table.
52. Water-jacket blast-furnace.
53. Furnace ore-bins.
54. Brückner roasting-cylinder.
55. Copper-refining furnace.
56. Large hand-roasting reverberatory.
57. Roasting-stall.
58. Cast-iron kettle
59. Large cupelling-furnace.
60. Small hand-roasting reverberatory.
61. Small cupelling-furnace
62. Pot-furnaces.
63. Space to grow in.
64. Professors' laboratory.
65. Table for electrolytic work.
66. Experimental *Spitzlutte*.
67. Chemical desks.
68. Hood.
69. Blow-pipe room.
70. Tables.
71. Cases for apparatus, etc.
72. Sink.
73. Library.
74. Book-cases.
75. Space to grow in.
76. Table.
77. Professors' desks.
78. Lithographic notes, etc.
79. Toilet-room.
80. Lockers.
81. Basins.
82. Closets.
83. Professors' room.
84. Stack.

These laboratories are located in the basement of the Rogers building, in the main building of the Institute, and comprise the entire department of mining, engineering and metallurgy, with the exception of the lecture-rooms and collections. While at first * all the metallurgical work, including dry-assaying, was done in the room marked [48] and the milling-work in the space now covered by machines [13] and [16], there are to-day a separate furnace-room [48], an assay- and balance-room [37, 44], a milling-room [1] and a blow-pipe room [69]. To these may be added two storage-rooms [46, 47], a toilet-room [79], a library [73] and the private laboratory [64] and office [77]. Upon closer inspection, it will be seen that the apparatus is pretty closely crowded. Although there is some "space to grow" [33, 63, 75], and there are places near [1] and [33] still open. there is little room for additional permanent machinery, the available space being necessary for erecting temporary apparatus and giving room to move about in. A laboratory built to-day with a liberal allowance of space and of funds would probably be planned somewhat differently as regards general arrangement, and would also possess a larger amount and variety of apparatus. The work in it would be easier and could be more conveniently and quickly, but not better, done.

In discussing the machines and furnaces, sufficient data will be given to enable the reader to form a clear idea of the relation which the laboratory-apparatus bears to that used in large-scale work.

The apparatus of the laboratory is best classed under three heads, corresponding with its purposes :

A.—Concentrating.
B.—Sampling and assay.
C.—Metallurgical.

A.—Concentrating Apparatus.

1. *Coarse Crushing*.—Coarse-crushing is represented by the Blake Challenge rock-breaker [2], with a receiving-capacity of 4½ by 5 inches, and the Gates rock-breaker [4] with a receiving-hopper 12 inches in diameter. The machines are at a sufficient height above the platform to allow a wheelbarrow or bucket to be placed below the discharge. A pipe, connected with a small suction-fan, serves to carrry off the dust, if desirable. The Blake is used for crushing lump-ore, the jaws being set 1¼ inches apart ; the Gates for smaller sizes, the liners being set at ½ inch. The Dodge and Lowry crushers may be added to the plant if it is desired to crush ore more uniformly than can be done with the Blake or the Gates type ; but this will hardly be necessary for the testing of ores, although it might be useful for illustrating class-work. The small Taylor hand-crusher [20] is very convenient for breaking up specimens.

2. *Fine Crushing*.—For fine crushing there are : a pair of Cornish rolls, a stamp-battery, a non-discharging ball mill, sets of pans, a sample grinder, and bucking plates.

The Cornish rolls [3], 9 inches in diameter and 9 inches in face, are of chilled iron, without the outside shell so common for large scale work ; are driven by direct and cross belt, and make 70 revolutions per minute. The pressure on the sliding box is maintained by springs. The rolls have a large feed hopper, with adjustable discharge slot, holding about 100 pounds of quartzose ore. The crushed ore is directed by three converging pieces of sheet iron (a short, steep one at the back, and a long, flatter one on either side), towards an oblong opening, 5½ by 27 inches, through which it drops into an oblong sheet-iron box, 14 by 36 inches, of No. 22 iron, with sides 6 inches and ends 4 inches deep. The upper edges of all sheet iron boxes or vessels used in the laboratory are bent around a ¼-inch iron rod to give them strength, and are painted with asphalt varnish. If the ore is to be screened, an oblong wooden screen frame, 54 by 11 inches inside dimensions, made of 2½ by ⅞-inch wood, and closed at the upper end, is suspended in a slightly inclined position from four iron ($\frac{5}{16}$-inch) hooks from the wooden frame of the rolls, and oscillated by an excentric of 1-inch throw and 200 shakes per minute, driven from the main shaft below. The ore drops upon a piece of sheet iron, 11 by 12 inches, in the upper end of the frame, passing over which it comes to the screen (54 by 12¾ inches). Through this the finer parts fall into a sheet iron box, while the coarser ones are carried over into another which adjoins the first. The screens are fastened to the lower sides of their frames by means of angle hoop-iron and screws.

The crushing capacity of the rolls per hour is 600 pounds of quartzose ore to ¼-inch size, or 300 pounds to ⅛-inch, or 150 pounds to $\frac{1}{16}$-inch. While they serve their purpose for fine crushing, as a preliminary operation in ore dressing, yet, if ore is to be rolled previous to chloridizing and leaching, Krom rolls are very desirable for finishing, the Cornish rolls serving in that case as roughing rolls.

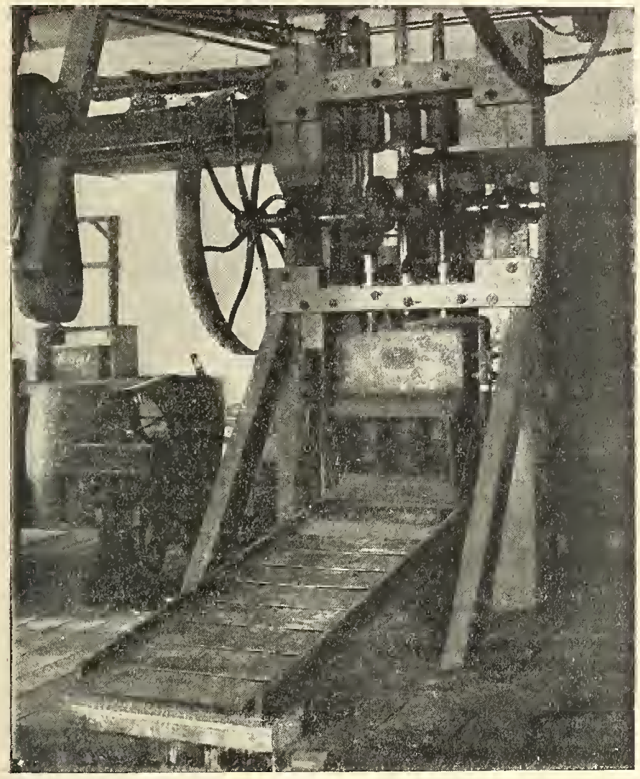
Roller mills, such as the Huntington, Griffin, and Tustin, or discharging ball mills, such as the Brückner, while doing satisfactory work in dry and wet rolling, are better suited for the mill than the laboratory, on account of the difficulty of cleaning up.

The stamp battery [14 and Fig. 2] is of the California pattern. It has the usual single discharge mortar for wet crushing, but only three stamps ; the weight of the stamps is 228 pounds ; the mortar bottom is 19¾ by 6 inches ; the depth 5 inches ; the discharge surface 20 by 10½ inches ; the screen-frame 21½ by 13 inches ; and the screen surface 18⅞ by 9¼ inches. The cams permit the lifting of the stamps to a height of 8 inches. The rate of crushing Nova Scotia gold quartz with a 7-inch height of discharge, a length of drop of 5¼ inches and 98 drops per minute is 3,353 pounds in twenty-four hours, or 1 pound for every 4,198 foot-pounds developed. With a 7½-inch drop and 60 drops per minute, it is 2,117 pounds, or 1 pound for every 5,816 foot-pounds. The coarsely crushed ore is fed to the battery by a Hendy Improved Challenge Ore Feeder [13]. A double discharge mortar, of which one side can be closed by an iron plate, will soon replace the old mortar, so that in the laboratory it will be possible to do both dry and wet stamping. In planning a new mill a battery with three stamps would not be chosen. The choice would lie between a 5-stamp battery of light stamps, say 300 pounds each, a 1 or 2-stamp battery, the stamp weighing 750 pounds, and a steam stamp. The 5-stamp battery has the advantage that the same number of stamps is used as in common practice. It would not be feasible to have a full size 5-stamp battery, as it entails too much work and requires more ore than is convenient and suitable for experimental work in the laboratory. The 1 or 2-stamp battery with 750 pound stamps dropping in a narrow double discharge mortar, one side of which could be closed at will, the discharge to be on a level with the base of the die and to be raised by chuck blocks to 16 inches, and the stamps to have a length of drop of from 4 to 10 inches, would be very acceptable. The results obtained with it would resemble very closely those of large scale work. As to the desirability of a steam stamp for laboratory use, the writer feels himself at present unable to express an opinion.

* R. W. Raymond, Statistics of Mines and Mining, 1874, pp. 499 and 500.

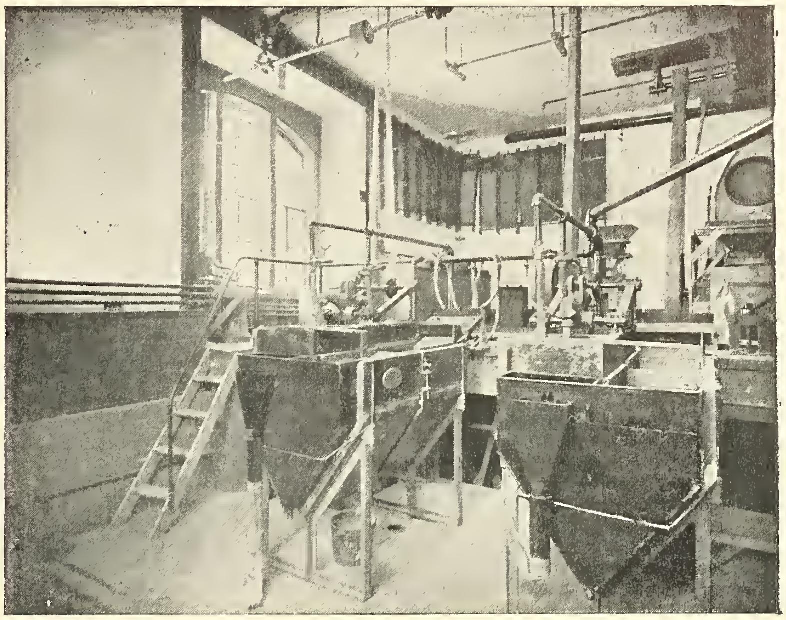
The Equipment of Mining and Metallurgical Laboratories.

FIG. 2.



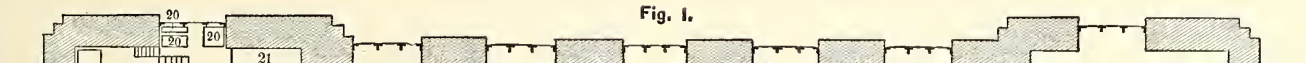
Stamp-Battery and Amalgamated Plates.

FIG. 3.



A Pair of Two-Sieve Collom Jigs.

Fig. I.



PLAN OF JOHN CUMMINGS LABORATORY OF MINING ENGINEERING AND METALLURGY.

0 20 40 60 80 100 FT.

The other fine-crushing apparatus, such as the ball-mill, the pan, the sample-grinder, the bucking-plate, etc., will be discussed under the heads of sampling and metallurgical apparatus.

3. *Sizing.*—The sizing or sifting of ore is more tedious in the laboratory than it is in the mill, because the screening surface is necessarily smaller, and all sifting has to be done without the use of water. If there is only a moderate quantity of ore, the sizing is best done by hand on a platform covered with an iron plate [6]. Sieves with wooden frames from 24 to 18 inches in diameter, and iron or brass wire-gauze having from 4 to 20 meshes to the linear inch, are well suited for this purpose. With very small quantities of ore, nests of sieves with metal frames, 8 inches in diameter, and wire-gauze ranging from 20 to 120-mesh are convenient; the screenings to be caught in a metal pan. With large quantities of ore the sifting has to be done by machinery, and the shaking sieves referred to above are used for this purpose. There are fourteen of these, representing the sizes 2-, 4-, 5-, 6-, 8-, 10-, 12-, 16-, 20-, 30-, 40-, 50-, 60- and 80-mesh. They sift per hour about 2,000 pounds of 8-mesh ore, 1,000 pounds of ore ranging from 14- to 30-mesh, 300 pounds of 50-mesh, and about 150 pounds of 60- to 80-mesh material. As this work is somewhat slow, it is better to do it in separate sizing-boxes. Two inclined boxes, having screens of 3-, 10-, 18-, 30- and 60-mesh, and 4-, 8-, 14-, 24-, 24- and 50-mesh respectively, are satisfactory for the purpose. They are made of ½-inch pine, are 90 inches long, 18 inches wide and 5 inches deep, and have wooden covers screwed down on a felt band. They are oscillated 200 times per minute, by an eccentric and connecting rod, which gives them an end-shake. The ore is fed into the hopper at the upper end, and drops on a piece of galvanized iron, whence it passes on to the first (the coarsest) sieve. What is too coarse to pass strikes a dam at the opposite end and is discharged into a vertical spout at the side, to which a cloth bag is attached, through which it passes into a pail. It would seem as if the Coxe gyrating screen, which does such excellent work in sizing all sorts of minerals, might well be suited for laboratory purposes, either in the form of a single screen or a nest of screens. The trommels, as commonly employed in large scale working plants, are out of place in a laboratory. If a trommel is to be used, the polygonal form seems the most suitable, as the different screens could be easily adjusted and removed. It would be necessary in all cases to house the trommel.

4. *Hydraulic Classification.*—Hydraulic grading is done at present in the Institute laboratory only in an ascending current of water. Grading in a horizontal current of water, or *Spitzkasten*, will shortly be introduced, as it has been proved to be indispensible for the successful working-up of fine slimes. Now the fine sands and slimes are only settled, but not graded. Hydraulic classification is practiced with small samples of finely-pulverized ore, as a preliminary test before working small lots. The samples are treated in the Richards pointed tube,* where the mixed sands, held in equilibrium by an ascending stream of water are, by slightly slackening the current, drawn off slowly into the glass bulb, which, when filled, is exchanged for another. The contents of each bulb are then separately sifted through a nest of graded sieves, and weighed and examined, to find out just how effective the work has been, and what will be the best sieve-size for the trial test. In working, the material, after it has been crushed to the proper size, is passed through the automatic feed-trough [8], or the Cornish feeder [7], into a Richards *Spitzlutte* [9], when the discharge of the spigot will go to the jigs [10 and 11] and the overflow either to the vanner [16] or the slime-table]12], or first to the former, and, as tailings, to the latter. It is proposed to have the overflow, when worked directly on the slime-table, run first over a *Spitzkasten*, and then to feed separately the spigot-discharge, thus insuring better work. Another way of using the Richards *Spitzlutte* is to feed only carefully-sized ore, when the spigot, in many cases, will give clean heads and the overflow clean tailings, provided there are no included grains. The capacity of the *Spitzlutte* with a ½-inch spigot, is about three-quarters of a ton of sized material to 1 ton of mixed material per hour.

The automatic feed trough and the Cornish feeder serve to convert dry pulverized ore into liquid pulp, delivering it to the *Spitzlutte*, the jigs or the slime washers. The feed trough is of wrought-iron, 10 inches wide at the top, 3 inches at the bottom and 7 feet long, and is placed in an inclined position on a wooden trestle. On the inner side the trough is marked off, so that the same quantity of ore may be washed down by the travelling jet in the same interval of time, which is usually one minute. The travelling jet is a ¾-inch iron pipe, pointed downward and fixed in a wooden truck, having two of its wheels on one edge of the trough and the other on a rail 3 inches away from the opposite edge. The pipe is connected by a rubber hose with the water main. The carriage is pulled up the inclined trough by a weighted cord, running over a pulley at the upper end of the trough to a shaft near the roof, around which it is wound once or twice and kept taut by the weight. To this weight is fastened a second cord, running over a pulley near the roof to the lower end of the trough, which serves to raise the weight, and thus to lower the carriage. In order to prevent the rubber hose from obstructing the upward travel of the carriage and the even flow of the water, it is suspended from the rail by small grooved wheels, and the loops are replaced by 6 iron pipe return bends. Thus the suspended hose shows three zigzags, which are close together when the carriage is at the lower end of the trough, and separate as it travels upward, but are held together at the upper ends by strings, which do not allow them to get more than 24 inches apart.

The Cornish automatic feeder is a four-sided truncated pyramid of sheet-iron. It is 24 inches high, and the bases are 18 and 12 inches square. To the smaller base are attached four legs, on which it stands in a sheet-iron box, 16 inches square and 6 inches deep, contracted at one end into a spout. The legs (pieces of angle iron) firmly connect the hopper and the box, leaving a distance of ½-inch between them for the ore to pass through. This is charged into the hopper and washed down the spout by a jet of water playing usually between the walls of hopper and box, but occasionally (if especially quick feeding is desired), upon the ore in the hopper.

5. *Jigging.*—The jigs in use for water sorting are plunger jigs and movable sieve jigs. The former are represented by two Collom jigs [10 and 11 and Fig. 3], used for ores ranging from 30 to 5-mesh, the latter by a Richard's jig [17] for sizes larger than 5-mesh.

The Collom jigs are two compartment machines. They are supported by a V-shaped iron frame on either end. The screen frames are 12½ by 18½ inches. The length of stroke is adjustable to ¾-inch and the number of strokes can be varied by the use of three-step pulleys, 8, 10 and 12 inches in diameter, from 130 to 180 per minute. The ore coming from the feed trough, the feed hopper or the spigot of the *Spitzkasten* travels over the jig, while the tailings at the opposite end are collected and unwatered in a sheet-iron box. From this they are drawn at intervals, while the water which overflows goes into the water tanks [18]. The jigs have no automatic discharge for concentrates; since, for the purposes of instruction and experiment, it is better to stop them every little while and skim off the different layers formed. The manner of working, therefore, is the same as that of large scale one-compartment jigs. The reason for having a two-compartment jig is that "every machine as far as practicable, should have its guard."† Any middle product not remaining on the first sieve will be collected on the second sieve and thus prevented from passing off into the tailings. The Collom jigs here described were put in to replace two three-compartment Harz jigs formerly in use, the screen frames of which 16 by 12¾ inches, were much too small to do satisfactory work. The reciprocating motion was derived from an excentric adjustable to 2 inches; and the number of strokes could be varied from 100 to 200 per minute by four step-pulleys, 6, 7½, 9 and 10½ inches in diameter. The jigs had an automatic side discharge for heads.

The movable sieve jig serves to illustrate the lectures, to work ore coarser than 5-mesh and to do the water sorting in graded crushing and jigging. The sieve frame is 14 inches wide, 22 inches long and 12 inches deep, the ore bed can reach a depth of 10 inches. The rods of the screen frame, ¾-inch in diameter, are divided into two parts to facilitate taking the machine apart. The two lower or jigging rods, 48 inches long, are forked at their lower ends and have an eye at the top through which passes a connecting rod, ¾-inch in diameter, suspended from the upper or excentric rods, which are 25 inches long. The excentrics are adjustable to 2 inches, the excentric shaft is 51 inches long and 1⅝ inches in diameter. It has a conical pulley with seven steps, its smallest diameter being six inches, its largest 8¼ inches. The number of strokes per minute ranges from 100 to 200. The counter shaft is placed 14 inches above the excentric shaft; and the whole is attached to a strong wooden frame. The water tank in which the ore is jigged is 33 inches long, 27 inches wide and 22 inches deep. Small boards extending from the sides into the tank serve as guides for the screen frame. The hutch work is drawn off at the sides; the tank rests on a wooden box and its top is 36 inches from the floor.

6. *Slime-Washing.*—Of the different machines in common use for working slimes [*i.e.*, material not coarser than 30-mesh] only two are represented in the laboratory: a Frue vanner [16] and a convex continuous round table [12]; a greater variety being excluded by the lack of space.

The Frue vanner is of normal size, *i.e.*, it has an inclined rubber surface 4 feet wide and 12 feet long. Either plane or corrugated belts are used. The normal adjustment for full work in the laboratory [inclination of belt 3½ inches in 12 feet, travel of belt 32 inches per minute, and 195 shakes of 1-inch throw per minute] has to be changed, if the pulp flows directly from the light three-stamp battery upon the vanner, as the battery furnishes only about 1½ tons of pulp in twenty-four hours, while the normal rate of the vanner is 5 tons. The simplest way is to change the inclination to 2½ inches in 12 feet and to regulate the flow of water accordingly. If the vanner is to do full work, the pulp from the battery is collected in the settling tanks and fed at the required rate and with the necessary water by the Hendy feeder of the stamp-battery. In order to permit this, the connecting-rod of the friction-plate is replaced by an excentric rod, the excentric of which has a 2-inch throw, and is on a small counter-shaft near the ceiling. The counter-shaft is driven from the upper shaft of the laboratory and makes 100 revolutions per minute. The ore which is fed by the carrier-plate is washed by a jet of water into a sheet-iron trough and conducted from behind the mortar into the ore-spreader of the vanner.

The convex continuous round table is 8 feet in diameter and has a slope of ¾ inch to the foot. It is of ⅛-inch sheet-iron, painted with tar, sanded and rubbed smooth, and is supported by an umbrella-frame. It receives its pulp from a fan-shaped distributor, which discharges against one side of a central cone, 14 inches high and 18 inches in diameter, and its wash-water on the opposite side from a horizontal curved pipe with perforations on the inner side. The three products, tailings, middlings and heads, flow into a circular launder. The compartments for heads and middlings are 12 inches wide and hopper-shaped; that for the tailings is 6 inches wide. The heads and middlings are drawn off at intervals into a pail; the water of the heads compartment overflows into that of the middlings, and the overflow of these into the tailings launder. The heads are washed off by jets of water; the middlings are sprayed in the usual way. The machine treats from 1 to 1½ tons of ore per day.

There are in the laboratory, of course, the ordinary implements for panning and vanning to check the work done by jigging and slime-washing, and to assist in amalgamating operations.

7. *Electro-Magnetic Separation.*—The magnetic separation of magnetite or of iron ore rendered magnetic by a preliminary roasting is represented by a small Chase endless-belt machine * placed near the tank [32]. This receives the waste-water from a 6-inch Pelton water-wheel which drives the concentrator. Many interesting data of magnetic separation are recorded in the journal of the laboratory. It may be incidentally remarked that a small Pelton wheel forms a most satisfactory motor for any apparatus that is to be driven independently in a laboratory having water under pressure at its disposal. Of course, a pressure-regulator is necessary to equalize the uneven flow obtaining in a city main.

8. *Dry Concentration.*—There are no arrangements in the laboratory for dry concentration. To make tests that would be in any way satisfactory would require too much space.

9. *Distribution of Power and Water.*—The machinery of the laboratory is driven by a 15 horse-power upright engine [24] having a common side-valve. Its cylinder is 9 inches in diameter; it has a 9-inch stroke, and is usually run at 200 revolutions per minute. The main shaft, 1¾ inches in diameter, is on the ground floor and runs the entire length of the milling-room. Its position is approximately indicated by Nos. 1 and 3 in the plan (Fig. 1). It makes 240 revolutions per minute. Near the double ball-grinding mill [36.1] it is connected with the counter-shaft of the same diameter placed near the ceiling. This also runs the entire length of the mill-room along the center line of the Frue vanner. It makes 200 revolutions per minute. Thus the different machines are set in motion either from the main or counter-shaft, the choice depending upon the location and direction of the belts.

The large dynamo [25], an Eddy shunt-wound machine of 50 volts and 50 amperes, is driven at the rate of 2,200 revolutions per minute. It has a separate driving shaft, 1¾ inches in diameter, making 550 revolutions per minute. The small dynamo [26], also an Eddy machine of 2 volts and 50 amperes, is connected with a counter shaft, and makes 1,400 revolutions per minute. Electricity has so far been used in the laboratory only for the separation of ores and for the deposition of metals. For electric fusion a differently wound dynamo would have to be added, in order to secure the necessary amperage.

The water required in the laboratory is received from the city main, but is not conducted directly to the different machines, since there would be no regularity in the flow. It runs into the end compartment of the water-tank [18], from the bottom of which a centrifugal pump, 18 inches in diameter, delivers it into a 2-inch main pipe running along the upper platform, on which are placed the machines Nos. 13, 14, 18, etc. Two-inch tees supply the different machines from the top of the main. By the aid of separate pipes and 3-way cocks the overflow from the jigs can be pumped upon either the vanner or the round table, the overflow of the vanner upon the table, and the contents of the settling tanks upon any of the washing-machines or into the sewer.

10. *Auxiliary Apparatus*—By referring to the plan (Fig. 1) and its legend, the different auxiliary apparatus used in ore dressing and in metallurgical work can easily be seen. Prominent among these are, for instance, the steam drying tables [19], on which the products are dried so as to permit comparison of the weights of ore before and after treatment.

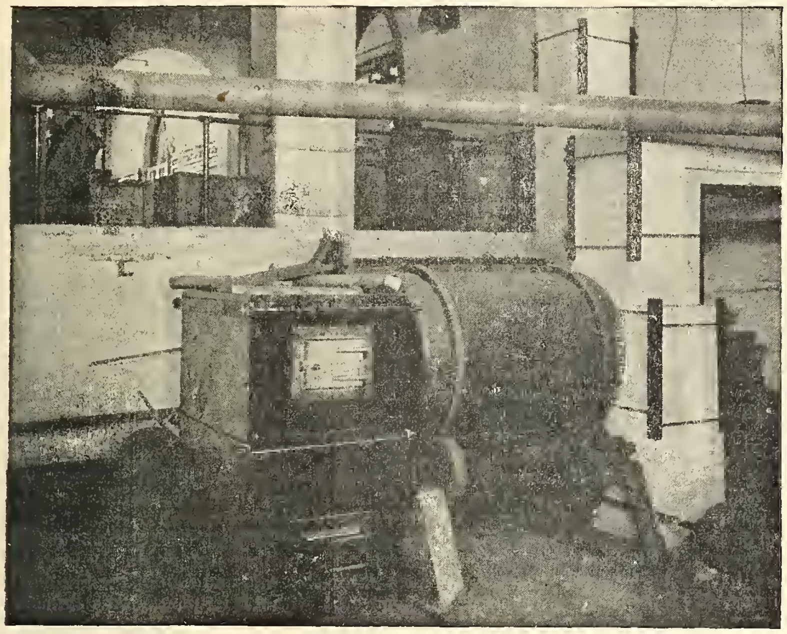
The plan does not show the thirty odd large bins, 4 feet wide, 4 feet deep and 4-

* Trans., xxiv., 438.
†Richards, Trans., xxii., 701.

* Trans., xxi., 503.

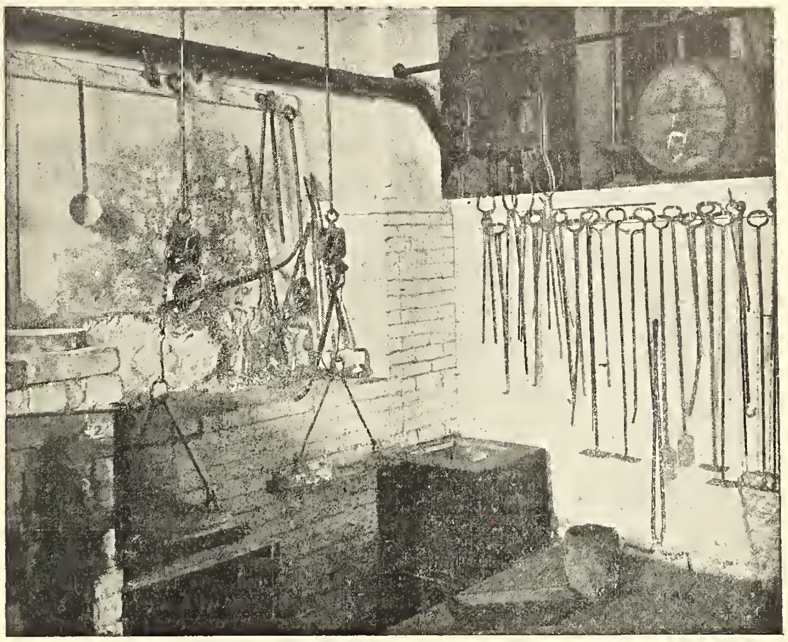
The Equipment of Mining and Metallurgical Laboratories

Fig. 4.



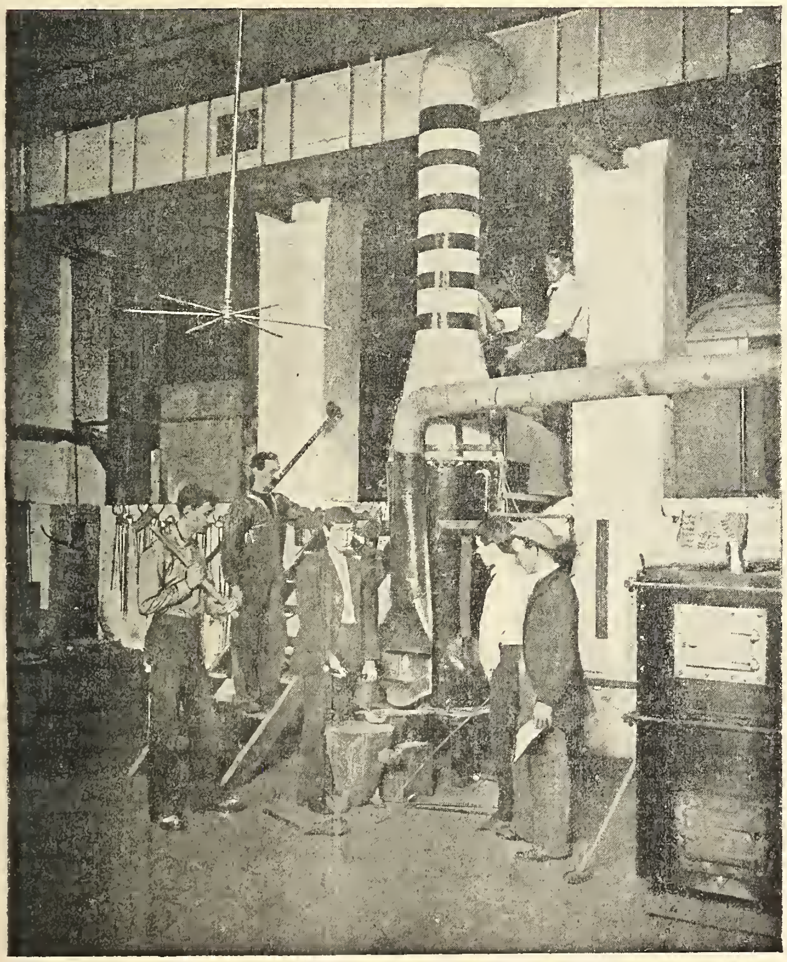
Brückner Roasting Furnace.

Fig. 6.



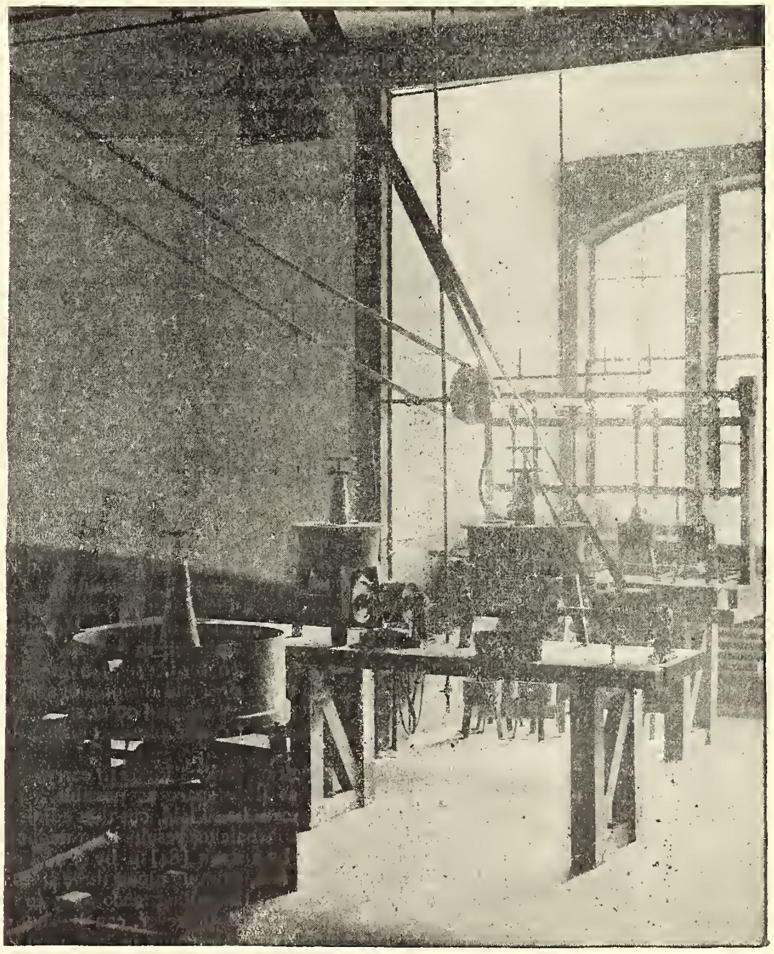
Furnace for Pot-Melting, with Travelling Lift for Covers.

Fig. 5.



Water-Jacket Furnace for Smelting Lead and Copper Ores.

Fig. 7.



Laboratory Amalgamating-Pans.

feet high, for ores, fluxes, fuels and intermediary products. They are accessible from the furnace room by two doors, and from the milling room by one door.

B.—SAMPLING AND ASSAYING APPARATUS.

Ore sampling is generally done in the laboratory by hand. If it is desirable to do mechanical sampling, only intermittent machines—those which take the whole of a stream of ore at stated intervals—are allowable. The small-size machines of Bridgman and Constant do good work. Ores are crushed in rock-breakers and rolls and pulverized in the Hendrie and Bolthoff sample grinder [5] or on bucking plates [20]. Samples for analytical purposes are ground fine in four Morrel agate mortars [24.1]. These ores are all sampled by hand on the iron sampling floor [6] or on the sampling table [21]. Liquid pulp, fed upon or coming from washing machines, is passed through specially constructed automatic samplers (see *e.g.*, Fig. 2). Samples from alloys are taken by chipping, punching, sawing and boring [35]. In laboratory instruction too little stress is apt to be laid on the sampling of ores and metallurgical products. It is a most important and necessary part of the work, the whole of which is really invalidated if the sampling is inaccurate.

Assaying, in its broadest meaning, includes the quick quantitative determination of any element or compound met with in metallurgical work, embracing not only fire assays but also what is known as analytical work on solids, liquids and gases. In the Institute metallurgical laboratory assaying is restricted to fire work (except as regards the parting of doré silver buttons or chlorination assays). All analytical work is done in the chemical laboratories. The assay laboratory has two divisions: the assay room proper [37], and the balance room [44]. The assay room has eight pulp balances [39], weighing accurately to 1 milligramme with a load of 60 grammes, and six flux balances, accurate to 0.1 gramme with a load of 600 grammes. They are distributed among the students' desks [38], of which there are fifty. There are twelve crucible furnaces [41]; nine muffle furnaces [40], three of which have lately been erected in "the space to grow" [63]; and, lastly, an iron table [43] for hot crucibles, etc. Under the table is a shelf for crucible and scorifier moulds, and beneath this are small bins for fuels. Along the side of the table are four posts, with anvils for breaking crucibles, hammering buttons, etc. The crucible furnaces are 27 inches high and 12 by 12 inches in the clear. They are enclosed in wrought iron plates, and thus firmly held together. The top of each furnace is horizontal, and is covered by a fire-clay tile, around which is shrunk an iron band, with two hooks riveted to it. The cover is suspended from a wire cord passing over a pulley attached to the ceiling, a counter-weight being at the other end.

The muffle-furnaces are of different kinds and sizes. Five are Judson coke-furnaces, two with muffles, 4 by 7 inches, closed at one end, and three with muffles 8 by 16 inches, open at both ends; also, three coke-furnaces, with sheet-iron housing and fire-brick lining, having muffles 7 by 12 inches, closed at one end; and, lastly, one two-muffle furnace for bituminous coal, with muffles, 6 by 13 inches, open at both ends. Oil- and gas-furnaces are not used. The draft for all the furnaces is furnished by one main chimney [42], 2 by 3 feet, and about 80 feet high.

The balance-room contains one analytical balance and nine button-balances [45]. The principal aim has been to have the leading makers, such as Ainsworth, Becker, Oertling, Troemner and others, represented. The balances are accurate to 0.01 milligramme, with a maximum load of 0.5 gramme.

C.—METALLURGICAL APPARATUS.

While the various operations of the concentration of ores and fuels can be carried on in a school- or general experimental laboratory so as to give practical results, the case is likely to be somewhat altered when it comes to metallurgical processes. If we take, *e.g.*, a leading process—that of smelting in the blast-furnace, we cannot reduce the operations to a laboratory-scale, and obtain results which will serve as a guide for practical work. Nevertheless, smelting in the blast-furnace ought to be a part of the laboratory work, on account of its educational value. If a student receives for treatment a batch of ore, examines it mineralogically and chemically, makes the necessary analytical determinations of his fluxes and fuel, calculates his charge, smelts it and sums up his results by weighing, assaying and analyzing the products, he learns more about smelting than any amount of lecturing or cursory visiting of works can ever teach him. Only by taking hold himself and carrying a process through to the end, can he learn how to think metallurgically, and thus become really qualified to listen intelligently to what is taught in the class-room.

There are, however, many metallurgical processes—such as roasting, amalgamating, leaching, electro-deposition and other operations—which can be performed in the laboratory on a small scale with trustworthy economic results. In fact, the engineer is guided, in the planning of amalgamating- and leaching-mills, by the results obtained in such laboratory-experiments. This class of work should therefore have a prominent place in the laboratory. From what has been said, it will be evident that most operations relating to the metallurgy of iron and steel must be excluded. Attempts have been made to imitate large-scale iron and steel-work in the laboratory. For instance, the Sheffield Technical School, in England, has a small open-hearth steel-furnace; the Polytechnic School of Aix-la-Chapelle, Germany, has a small puddling-furnace; but the writer, though not acquainted with the results obtained, is much inclined to doubt whether they will be found to justify the large outlay of time and labor involved. We must always keep in mind that it is not the province of an engineering school to perfect the student in any one branch of his profession, so much as to ground him in the fundamental principles upon which he is, later, to build for himself in detail.

In the laboratory of the Institute the processes chosen for instruction are those involved in the treatment of lead, copper, gold and silver ores and the ores of some of the minor metals, although it should be added that crucible-work and other small-scale heat-treatment of iron and steel, especially with regard to their physical properties, are not excluded.

The furnace-room [48] contains apparatus enough of various kinds to carry on all the necessary operations, so arranged as to occupy as little space as possible. This forces a crowding of the furnaces; but as the work can be so laid out that adjoining furnaces need not be used at the same time, less inconvenience results than might be at first supposed. The necessary draft is furnished by a stack [84] 2 by 3 feet and about 80 feet high. A horizontal main flue, 3 by 3 feet, running along three sides of the room—sometimes near the ground, sometimes near the ceiling, according to the height of the furnaces—collects the gases. Each furnace, however, can be shut off from it by a damper in its branch-flue. Too much stress can hardly be laid upon the necessity of securing a strong draught. The main and branch-flues should be large, and the stack of ample section and sufficient height, so that it shall be possible to run each of the furnaces alone or any number or all of them together. With a well-fitting damper, it is an easy matter to cut off too much draft; if there is too little, the result is fatal.

1. *Roasting.*—For this purpose there are three reverberatory furnaces and one stall.

The large hand-reverberatory [56] covers 8 feet 2 inches by 5 feet 7 inches, and is 4 feet 8 inches high. Its hearth is 4 feet 2 inches long and 3 feet wide, and lies 9½ inches below the top of the fire-bridge, which is 9 inches wide. The height of the 9-inch side wall is 11 inches to the spring of the arch, the height of the arch 5 inches. The furnace has one working door, 14 by 9 inches in size, and 2 feet 10 inches from the ground. The gases pass off through three openings, 9 by 9 inches, in the roof, into a branch flue running across the furnace and ending in the main flue. The fire-place, 2 feet 3 inches by 1 foot 9 inches, lies 16 inches below the top of the bridge, which is 8 inches below the roof. It has a door 12 by 9 inches in size, and 2 feet 6 inches from the ground. The furnace treats charges of about 250 pounds of pyritic ore.

The outside dimensions of the small hand-reverberatory [60] are: Length, 8 feet; width, 2 feet 8 inches; height, 5 feet. The hearth is 2 feet square and 6½ inches below the top of the bridge, which is 3 inches wide. The height of the 4½-inch side-wall is 8 inches to the spring of the arch, and that of the arch is 5½ inches. The working door is 9 by 6 inches, and 2 feet 10 inches from the floor; the flue running over the furnace is 5 inches square. The fireplace, 1 by 2 feet, is 10 inches below the top of the bridge, which is 7 inches below the roof, and its door, 9 by 6 inches, is 2 feet 6 inches above the floor. The furnace works small charges, of say, 25 pounds of pyritic ore.

The drawback of roasting in such small reverberatories is that the charge is liable to become too much cooled near the working door. If there had been more room, both roasting furnaces would have been constructed, like the reverberatory smelting furnace, with the working door at the end and the flue just above it; the air necessary for roasting being admitted through the hollow bridge. It might also be an improvement to have the hearth built in an iron pan, and so arranged as to permit its being removed, cleaned, and examined after an operation, although this is not so necessary in roasting as in smelting.

The third reverberatory roasting furnace, the Brückner cylinder [54 and Fig. 4], gives opportunity to study the behavior of an ore on a revolving hearth. The outside dimensions are: Length, 6 feet, and diameter 2 feet 8½ inches. The cylinder is of $\frac{3}{16}$-inch boiler-iron, and has a 2½-inch fire-brick lining. The throat is 12 inches, and the charging hole 8 inches in diameter. The cylinder, the axis of which is 3 feet 5 inches above the ground, revolves on two iron friction rings (35 inches in diameter), which rest on four 12-inch carrying rollers. One of the carrying roller shafts ($2\frac{7}{16}$ inches in diameter), is rotated by a worm gear (62 teeth of 1-inch pitch), at the rate of 20 revolutions per hour. The fire-box is detached and rests on castor wheels. By removing the box backwards or sidewise, the amount of air admitted can be increased. An additional improvement would be to make the throat of the fire-box muffle-shaped, leaving that of the furnace circular. In order to have complete control over the flame, the grate (18 by 24 inches), is laid 20 inches below the bridge. The carbonic oxide gas generated is burned by warmed air entering the furnace just above the bridge, after having been forced through five flues in the side wall and roof of the fire-box. The ash-pit, 8 inches deep, is closed and connected with a blast-pipe. This furnace treats charges of about 200 pounds.

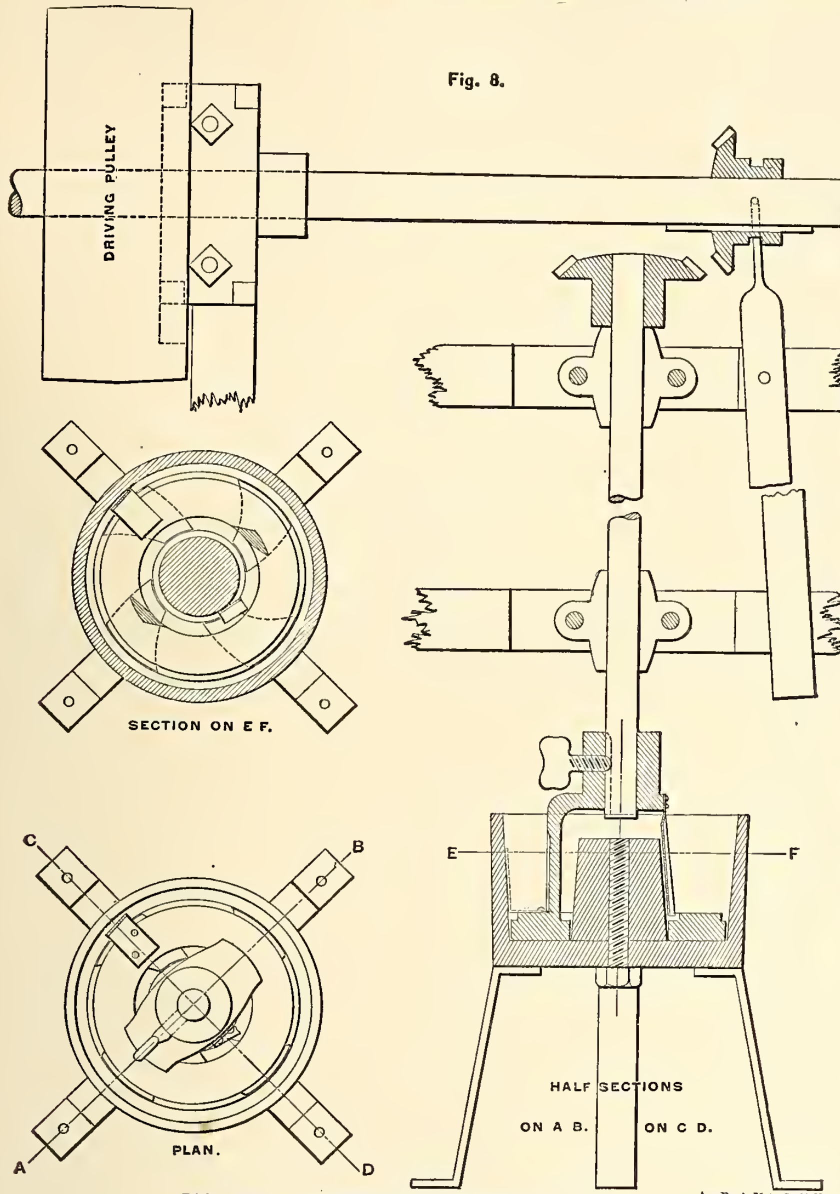
The stall [57], which completes the roasting apparatus, is commonly used for treating coarse copper-bearing pyrites previous to smelting in the blast furnace. It is 3 feet 3 inches deep, 2 feet 3 inches wide and 3 feet 7 inches high to the spring of the arch. The arch is 6 inches high. The walls are 4 inches thick and well anchored. The ore is roasted on a temporary grate of wrought iron bars. The front is bricked up half way, the upper half being closed by an iron plate with peep-hole. The charge varies from 1,500 to 2,000 pounds, and a roast lasts from two to three days. The results in desulphurization are very similar to those in large stalls. The management of the stall affords a splendid lesson in the regulation of draft.

2. *Smelting.*—Smelting is carried on in the blast-furnace, the reverberatory-furnace and the crucible-furnace.

The blast-furnace [52 and Fig. 5] has had to undergo several changes before it reached the present satisfactory form. The first furnace, 18 by 15 inches at the tuyere level, was built of brick. It had one tuyere at the back, run with a "nose" the ore being charged towards the back and the fuel towards the front. It would last one day, or perhaps two days, and then had to be relined. The next furnace, 18 by 16 inches, with three ordinary tuyeres, and charged in horizontal layers, burned out in less than a day. When provided, however, with one water-cooled tuyere at the back, projecting 8 inches, it was run successfully, and had to be relined only once a year. With this furnace ores were smelted for about six years, until, in 1884, the present one replaced it. This is a water-jacket furnace, resembling the circular copper-smelter in common use to-day. The height of the furnace, 6 feet 6½ inches, is divided as follows: height of four hollow cast-iron columns, 17½ inches; thickness of annular collar, 1 inch; distance to tuyeres, 1 foot; diameter of tuyeres, 2 inches, and height to feed-door, 3 feet 10 inches. The diameter at the bed-plate is 1 foot 5 inches; at the tuyeres, 1 foot 6 inches; at the throat, 1 foot 11 inches. The furnace has a conical hood 2 feet 9 inches high and 25 and 11 inches in diameter, which ends in a vertical flue leading into the main flue. The feed-door is 13 inches high, 14 and 9¾ inches wide. The water-jacket is of ⅜-inch boiler-iron and has a 3-inch water-space. The feed-water is supplied from the city main through a ¾ inch pipe near the top, the overflow-pipe being tapped into the upper-flange. There are four tuyere-holes, lined with solid bored blocks of bronze. The tuyere-pipes are of wrought-iron steam-pipe; the horizontal arm has at one end a conical turned bronze nozzle, at the other a T, the vertical leg of which is connected by a pipe with the tuyere-bag, and the horizontal leg, reduced in diameter by a bushing, is closed with a cap having a glass-covered peep-hole. The bustle-pipe is 4 inches in diameter. The bottom of the furnace is closed by a wrought-iron plate clamped to the collar of the four columns. The crucible is lined with brasque tamped in solid from above to the level of the tuyeres, and then cut out from below into the desired shape. the lining reaching up to the tuyeres.

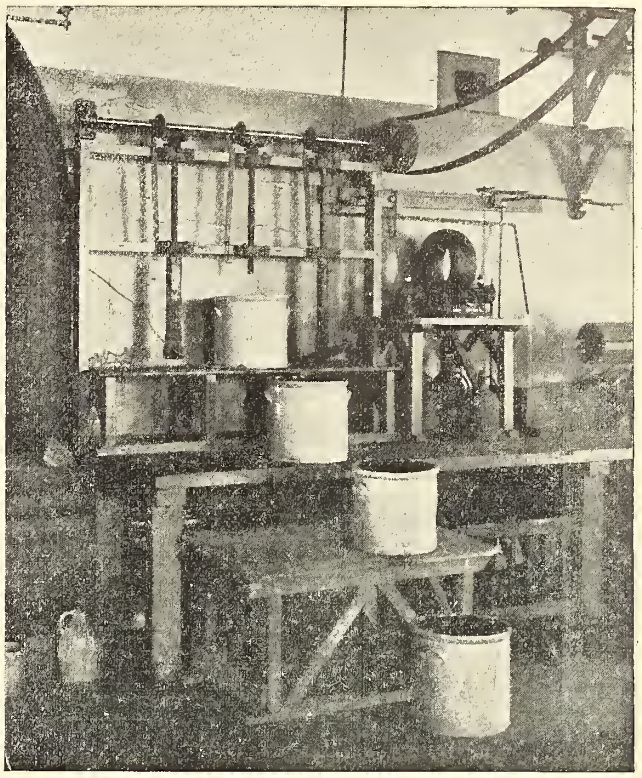
In tapping the melted masses from the furnace different methods were tried before the present one was adopted. With an internal crucible and separate metal- and slag-taps the metal easily became cool; with an external crucible and continuous flow it cooled even more quickly. The present practice is to tap the melted masses into a small cast-iron overflow-pot, having the form of an inverted pyramid 6 inches deep, 12½ inches square at the top and 2½ inches square at the bottom. This retains the metal, matte and foul slag, and is removed after every tapping by means of iron hooks inserted through rings on either side. The clean slag overflows into an ordinary conical slag pot, 14 inches in diameter and 16½ inches deep. A detached carriage serves to take away the full pots and return the empty ones. A devereux slag-pot may in the future replace the arrangement now in use. The fumes from tap-hole and slag-pot are drawn off by a hood connected with a small fan. The furnace has a daily smelting-capacity of about 6 tons of charge, not counting the fuel. It is not run, however, for 24 hours at a time. The furnace, warmed during the preceding day and night, is usually blown-in at 8 a.m. and blown down again about 4 p.m. This period is sufficient to give the student all the instruction that he can get from carrying on a smelting operation on such a small scale. Longer runs would mean greater physical exertion without corresponding benefit. When a run is completed, all the products are carefully separated and, if necessary, the matte adhering to foul slag or metal is separated by an additional crucible-fusion, and thus a complete account of stock is taken. With the present arrangements the loss of metal in flue-dust has to be arrived at indirectly by difference. It is proposed, however, to save the flue-dust, either by cooling or filtering or by wet condensation, and thus to obtain direct figures.

Fig. 8.



RICHARDS LABORATORY AMALGAMATING-PAN.
SCALE: 2 inches = 1 foot

Fig. 9.



Leaching-Tubs Arranged for Mechanical Stirring.

Three reverberatory smelting-furnaces were once considered necessary to fill the wants of the laboratory for agglomerating lead and copper-ores, smelting lead-ores, cupelling base bullion, bringing forward matte and refining copper. Two furnaces are sufficient. The English cupelling-furnace [59] serves for the last three operations; while the other two, formerly carried on in a reverberatory-furnace (replaced to-day by he Brückner cylinder) will be taken up again when the copper-refining furnace [55] has been rebuilt as a reverberatory furnace with movable hearth inclined from bridge to flue. The cupelling-furnace is of the ordinary pattern. The test is 18 by 24 inches, and is wedged fast against the test-ring; the fieplace 18 by 24 inches, is run with the under-wind; the grate is laid low, 20 inches below the top of the bridge, which is 9 inches wide and 15 inches below the roof. In order to burn the carbonic oxide gas formed there is a special tuyere in the side of the furnace just above the level of the bridge. In addition to the tuyere at the back of the hearth, there is a second one in the roof connected with a U-shaped pipe passing through the flue. Hot blast comes into play when a quick raising of the temperature is desired. The different kinds of reverberatory work so far practised in this furnace, such as liquating drosses on an iron plate, softening and cupelling base bullion on a hearth of limestone and clay, concentrating matte and refining copper on a hearth of a mixture of raw and burnt fire-clay or closely-fitted refractory tiles have been so satisfactory that the idea of a fixed hearth for laboratory-purposes has been entirely given up. In the furnace 150 pounds of base bullion, assaying about 150 ounces of silver per ton, are cupeled in 6 hours, or 200 pounds of black copper are brought through the different stages to tough-pitch copper in 7 hours.

The plan, Fig. 1, shows a small cupelling-furnace [61], which is used sometimes to refine impure silver from the English cupelling-furnace in quantities larger than can be satisfactorily treated in one of the muffle-furnaces. It has a small fire-place, 8 by 14 inches, and 15 inches deep, the flame rising from which strikes the fire-clay tile forming the roof, and is deflected so as to strike the silver (placed in an oval cupel-test, 8 x 14 inches, and 2 inches deep, filled with bone-ash).

Crucible-work is of considerable importance in a metallurgical laboratory, as it is not only adapted for independent experiments, but serves to bring into suitable form the different mixed products obtained in the processes carried out on a larger scale in the laboratory. Small crucibles are commonly heated in the assay-furnaces; for larger charges there are two pot-furnaces [62, and Fig. 6], worked with under-wind. They are 14 inches square and 23 inches deep; the blast is introduced through the ash-pit door, and the ash-pit is 9 inches deep. A furnace holds conveniently a No. 35 graphite crucible.

3. *Distillation and Sublimation.*—Both these operations are of subordinate importance in laboratory-work. Distillation of mercury is carried on in half-pint and one-pint bulb-retorts, which are heated over four-tube Bunsen burners. The delivery-pipe is cooled by suspending from it an iron trough filled with cotton-waste, which is kept wet. Reduction of zinc oxide or sublimation of arsenic, realgar and sulphur are rare operations, and no special apparatus is assigned for this purpose.

4. *Crystallization.*—The principal process coming under this head is the Pattinson process, for which a cast-iron kettle [58] is used, 21 inches in diameter and 14 inches deep, covered with a hood and heated by a fire-place 21 inches square. This kettle is rather small for the Pattinson process; it is the one in common use for desilverizing argentiferous lead by the Parkes process, and for melting and liquidating, in general, readily fusible metals and alloys.

5. *Amalgamation.*—The process of amalgamation is especially well adapted for laboratory-work, since small-scale experiments give results directly applicable to large-scale work. The different appliances for treating gold- and silver-ores in this way are therefore well represented. There are a stamp-battery, a ball-mill, two revolving barrels and a number of pans of different sizes.

The stamp-battery, as a pulverizer, has already been described under the head of fine-crushing. In using it for the amalgamation of gold-ores, the arrangement and management of the copper plates (see Fig. 2) differs from that of large-scale work in having five small plates, 24 by 11 inches, and $\frac{1}{16}$ inch thick, laid cross-wise over the apron-table, one overlapping the other,* instead of a single large sheet of copper, and also in not having inside plates. By having several outside plates, and cleaning them up separately, it can be seen how the gold saved decreases with the distance from the mortar-discharge, and the required length of plate can thus be determined. In order to prevent absorption of gold by the outside plate, it is coated with silver-amalgam. On an inside plate this would be scoured off and gold would be absorbed by the copper, thus vitiating the test; hence, inside plates are not recommended.

The ball-mill [36.1] is used for grinding and amalgamating small lots of gold ore and for cleaning up the battery residues. The plan shows a circular cast-iron [¾ in.] plate, 22 inches in diameter, on either end of a horizontal shaft, 2 inches in diameter and 27 inches long, in the center of which is the driving pulley, 20 inches in diameter. To each plate is bolted a flanged cylindrical box (7 inches deep, 17 inches in diameter and 1½ inches thick), having a 4-inch charging hole opposite the shaft, to be closed by a wooden bung, and a 1¼-inch discharge opening, to be closed by a screw-plug. From thirty to forty 1½ inch steel balls do the grinding. The mill makes 48 revolutions per minute, and works two charges of 15 pounds of ore in about ten hours.

The revolving barrel [26.1] serves for amalgamating without grinding, as well as for leaching. Its general arrangement is similar to that of the ball-mill. To either end of the horizontal shaft, 1½ inches in diameter and driven by a 20 inch pulley, is attached a wooden cylinder, 7 inches in diameter and 11 inches long, made of ⅞-inch staves which receives a 2-quart glass-stoppered fruit jar, made tight with a rubber washer and screw clamp. The jar is packed with felt into the wooden frame. The shaft makes from 20 to 25 revolutions per minute. Small lots of ore, of 1,000 grammes, more or less, are worked in about eight hours.

There are ten amalgamating pans [29 and 30, Figs. 7 and 8]. Three of these are accurate copies, in reduced size, of those used in practical work. They are 30, 18 and 12 inches in diameter, have sides 12, 8 and 6 inches deep and discharge into a 30-inch settler, 12 inches deep, making 15 revolutions per minute. They treat charges of 250, 30 and 20 pounds respectively, in from five to eight hours. The other seven pans

* Richards, Trans., viii., 362; Technology Quarterly iii., 45; Editorial, Engineering and Mining Journal, April 12, 1890, p. 418.

[Fig. 8] especially constructed for laboratory experiments, are only 7 inches in diameter. Three of these are of copper; the others of iron. The pan has a solid central core and no dies; the muller and shoes are cast in one; the pulp is prevented from settling on the core and sides by adjustable scrapers. The muller can be raised or lowered on the driving shaft, which is driven from above and easily thrown in and out of gear. The pans are heated by Bunsen burners. The muller makes 90 revolutions per minute and the pan works charges in three or more hours. The reason for choosing such small-sized pans is that in one day's work, two students will finish without outside help a set of experiments. They start, for example, in the morning, four pans with the same ore, treat it in four different ways and finish the cleaning-up in the afternoon. A larger pan or a pan of a more complicated construction will not permit this. In cleaning up, a large-sized Spitzlutte, 3¾ inches in diameter and 13 inches high, with a ¾-inch water inlet pipe is commonly used, as it does quick and effective work.

6. *Lixiviation*—The leaching of ores and intermediary products can be done in the laboratory in stationary vats by percolation, or by mechanical stirring, or in revolving barrels. For leaching by percolation there are two forty-gallon vats (not shown in the plan, Fig. 1) of wood lined with lead. These will be replaced with sheet-iron vats poured with melted roofing-pitch. For leaching in stationary vats with mechanical stirring there are three sets of 8-gallon vessels [28 and Fig. 9] of glazed earthenware, 12 inches in diameter and 14 inches deep. The wooden stirrers, with their iron driving shafts, make 75 revolutions per minute. For leaching in a revolving barrel the same apparatus is used as for amalgamation. Gold, silver and copper ores are commonly, and zinc and nickel ores occasionally, treated by wet processes in the laboratory

7. *Electro-Metallurgical Work*—Electricity has so far been used only for the refining of silver and gold-bearing copper. The large depositing table [27] holds the electrolytic baths. They are of wood pulp, poured with melted roofing-pitch, of glass or of earthenware, as the case may be. No definite sizes have been, so far, adopted, but electrodes are usually made 7 by 10 inches. The current is furnished by the dynamos already referred to; thermo-piles and storage batteries are not in use.

D.—CONCLUSION.

It is somewhat difficult to estimate the cost of the laboratory-apparatus, because one thing has been put in after another, and alterations have been frequently made. It could probably be duplicated for about $15,000. The annual cost of running the laboratory, excluding wages, fuel and power, is $1,200.

That it is conducted in connection with class-room work, and not independently, need hardly be mentioned. With the school-courses of the fourth year the students are thoroughly trained in the laboratory, their work there supplementing and illustrating the lectures. The last term is largely devoted to the working up of theses, which are always founded on laboratory-experiment. While the student does not handle every apparatus, he sees most of them in operation. Every Saturday each student makes, before the assembled class, an oral report of his laboratory-work during the past week, and its continuation for the coming one is discussed and laid out. The whole class thus gets the benefit of the work of each individual member. The time devoted to laboratory-work is 325 hours, and to class-room work, including preparation, during the same year, 225 hours. The most satisfactory arrangement would be to have during the entire year two days a week for laboratory-work. One of these should be uninterrupted for making a complete experiment, the other might be divided into two half-days.

Experiments for Ascertaining the Comparative Effect of Explosives.*

In experiments for determining the effect of explosives, such determination can only be effected by comparing the explosive force of the various substances one with another, and also with one taken as a standard of comparison; and the most useful method for carrying out such tests is the Trauzl lead block, which was employed in the present case. The lead block has a cylindrical hole, inside which a determined quantity of the explosive to be tested is exploded; and the extension of the hole thus brought about serves as a measure of the explosive force of the substance in question.

The nearly cylindrical lead blocks used in the Schalke tests were prepared as shown by Fig. 1, having a height of 24 cm. (9½ in.) and a diameter of 14 cm. (5½ in.), a slightly conical form having been adopted for facilitating casting of the block. The cylindrical hole of 25 mm. (1 in.) diameter and 145 mm. (5⅜ in.) deep, is increased above, for receiving the cover, to a diameter of 60 mm. (2⅓ in.). The metal used was the best refined lead; and, in order to secure as uniform a composition as possible, all the blocks used in one experiment were cast at the same time.

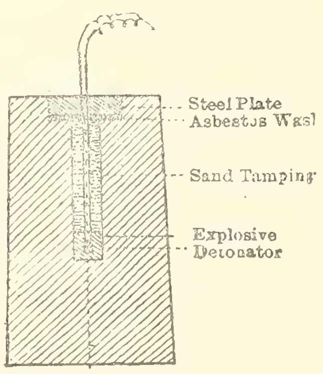


FIG. 1.

The explosive to be tested, contained in a paper case with detonator, was placed at the bottom of the hole, which was then filled up as far as the recess with dry, well-sifted sand, the hole being then covered with a steel plate over an asbestos washer, while, for introducing the wire of the electric detonator, the steel plate and asbestos washer were bored through in the middle.

* From a communication to Gluckauf, of Essen-an-der-Ruhr, by Bergassessor Winkhaus, originator and now director of the Explosives Testing Station, in the form of a mine-working, at the Consolidation I. Colliery, Schalke, Westphalia.

The lead block thus arranged was wedged tightly into a strong wrought-iron frame (shown by Figs. 2 and 3) with the assistance of an iron plate and two pairs of wedges. Both before and after firing, the size of the hole was measured by means of water in graduated test-tubes, the difference between the quantities showing the extension of the hole effected by the explosion.

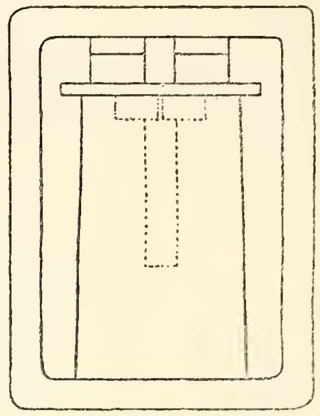


FIG. 2.

In order to carry out the tests under practically similar conditions with all the substances, the explosion was determined by the strongest detonators, No. 8 (containing 2 grammes of mercury fulminate), used with safety explosives.

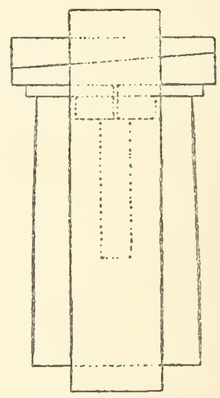


FIG. 3.

The series of experiments included the safety explosives now used in the mines of the Westphalia Superior Inspection district, as also gelatine-dynamite in order to afford a standard of comparison; and the results of these experiments, in which 10-gramme charges were always employed, are recorded in the following tables:—

GELATINE DYNAMITE.

Serial No. of Test.	Hole in Lead Block. Before explosion. Cub. cm.	Hole in Lead Block. After explosion. Cub. cm.	Increase of Hole. Cub. cm.	Mean Increase. Cub. cm.	Difference of Increase between each Test and the Mean. Cub. cm.	%
1....	62	696	634	....640....	− 6	0.94
2....	62	708	646		+ 6	0.94
3....	62	704	642		+ 2	0.31
4....	62	695	633		− 7	1.09
5....	62	703	641		+ 1	0.16
6....	62	708	646		+ 6	0.94

CARBONITE (KOHLEN-CARBONIT).

1....	62	278	212	....232....	−20	9.6
2....	62	295	233		+ 1	0.4
3....	62	301	239		+ 7	3.0
4....	62	281	219		−13	5.6
5....	62	321	259		+27	11.6

FIREDAMP DYNAMITE (WETTER DYNAMIT).

1....	62	384	322	....325....	− 3	0.92
2....	62	389	327		+ 2	0.61
3....	62	393	331		+ 6	1.84
4....	62	387	325		+ 0	0.00
5....	62	383	321		− 4	1.22

PROGRESSITE.

1....	62	465	403	....397....	+ 6	1.5
2....	62	476	414		+17	4.3
3....	62	467	405		+ 8	2.1
4....	62	429	367		− 30	7.6

WESTPHALITE.

1....	62	559	497	....470....	+27	5.7
2....	62	533	471		+ 1	0.2
3....	62	544	482		+12	2.6
4....	62	491	429		− 41	8.7

DAHMENITE.

1....	62	571	509	....495....	+14	2.8
2....	62	536	474		− 22	4.5
3....	62	557	495		− 10	0.0
4....	62	562	500		+ 5	1.0

DAHMENITE A.

1....	62	551	489	....502....	− 13	2.6
2....	62	550	488		− 14	2.8
3....	62	568	506		+ 4	0.8
4....	62	588	526		+24	4.8

ROBURITE.

1....	62	603	541	....549....	+ 8	1.4
2....	62	609	547		+ 2	0.4
3....	62	607	545		− 4	0.7
4....	62	625	563		+14	2.6

The analyses of the explosives tested are given as follows by various authorities. According to the president of the Berlin Mining Laboratory, gelatine-dynamite contains 64.5 per cent. of gelatinised nitro-glycerine, 26 per cent. of nitrate of potash, and 9.5 per cent. of ground wood, while the carbonate contained 25 per cent. of trinitro-glycerine.

Firedamp dynamite from the Schlebusch factory, Hamburg, contains 52.9 per cent. of trinitro-glycerine, 32.7 per cent. of epsom salts and 14.4 per cent. of fossil meal.

The composition of progressite is given as 92 per cent. of ammonia nitrate, 6 per cent. of aniline hydro-chlorate, and 2 per cent. of ammonia sulphate.

Westphalite, from the factory at Sinsen, consists of 94 per cent. of ammonia nitrate, 5.4 per cent. of resin, 0.4 per cent. of ammonia sulphate, and 0.1 per cent. of each of sal-ammoniac and smut.

Dahmenite, as made by the Castropher Sicherheits-Sprengstoff Actien-Gesellshaft, consists of 93.3 per cent. of ammonia nitrate, 4.8 per cent. of naphthaline, 1.6 per cent. of potash chloride, 0.1 per cent. of sal-ammoniac, and 0.2 per cent. of ammonia sulphate.

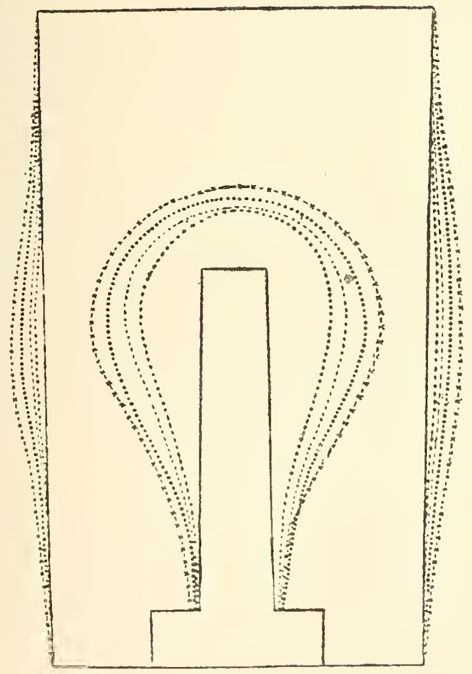


FIG. 4

Roburite from the factory at Witten-an-der-Ruhr consists of 17.8 per cent. of dinitro-benzol, 79.2 per cent. of ammonia nitrate, 0.3 per cent. of sal-ammoniac and ammonia sulphate, with the remaining 2.7 per cent. of moisture.

The results obtained reveal the curious fact that the inherent explosive values, with the same charges and under the same conditions, in the case of the explosives gelatine-dynamite and firedamp dynamite only differ slightly, at the most by 1 per cent., but, on the contrary, in the case of the other explosives, very considerably, in fact up to as much as 11.6 per cent. from the calculated mean value. It would appear that this circumstance can only be attributed to the composition of the explosive itself, which in the case of gelatine-dynamite and firedamp dynamite, are very uniform, while the other safety explosives appear to be much wanting in uniformity. A careful analysis of carbonite (Kohlen-Carbinit) showed, for instance, a higher nitro-glycerine content in the middle than at the outside. According, therefore, as more or less of the middle or the outside is used, there must follow a greater or less widening out of the hole. With a granular nature of the ammonia nitrate explosives there also comes into question the non-uniform granulation of the product.

If the mean content be compared, and the widening-out obtained with gelatine-dynamite (of 640 cubic centimetres) be called 1, the following figures will be obtained for the explosives in question :—

1. Gelatine-dynamite...... .... 1.000
2. Carbonite (Kohlen-Carbonit). 0.360
3. Firedamp dynamite................. 0.508
4. Progressite 0.620
5. Westphalite...................... 0.734
6. Dahmenite........................ 0.773
7. Dahmenite A...................... 0.784
8. Roburite......................... 0.858

The question now arises, how far, by means of the values thus found, conclusions may be drawn as to the action and suitability of the various explosives in practical mine working.

For showing the nature of their action, Fig. 4 gives a representation of the widening-out of the hole in the lead block effected by 10-gramme (⅓ oz.) charges of the explosives gelatine-dynamite, westphalite, firedamp dynamite, and carbonite—the lines made by roburite, dahmenite and progressite, which are very similar, being left out of the drawing so as to avoid confusion. In the case of all these extensions the space appears more or less bellied out, which results from such experiments with all high explosives, and differs considerably from the form made by a slow explosive such as blasting-powder, which latter (as shown in Fig. 5) was effected by a charge of 25 grammes (⅞ oz.), or two and a-half times the quantity used in the case of the other explosives. The space formed measures 61 cubic centimeters (3¾ cubic inches), giving a proportion with respect to gelatine-dynamite of 1.19, a figure which is quite contrary to the value obtained in practice. A comparison of explosives with very different speed of combustion is therefore not possible by means of the lead-block test. At the same time, however, in one with high explosives the acquired results are influenced by the most various circumstances.

First and foremost comes the resistance of the lead-block walls. As will be seen by the cross-section shown in Fig. 4, the thickness of the walls diminishes with the increase of the widening out, and accordingly also the resisting capability of the cylinders; for obtaining a considerable extension, a proportionately smaller power is therefore required than for the production of a small bellying. This is manifest from the following experiment :—Ten grammes of gelatine-dynamite gave a mean widening-out of 640 cubic centimetres (½ oz.), and 15 grammes a widening-out of 1,054 cubic centimetres, while, according to calculation, it should only amount to 960 cubic centimetres. (The widening-out due to the detonator alone can be left out of consideration in these comparisons, because experiment shows that it only amounts to 9 cubic centimetres.) The above circumstance must exert a specially unfavorable effect in the case of explosives which only give a slight widening-out; and it will, therefore, be more correct, in determining values for comparison, if those quantities of the various explosives be determined which are in the condition of producing the same widening-out of the hole. In such a case the explosive effect is in inverse proportion to the determined quantities of explosives.

Endeavors have been made to determine these weights; and the following proportions have been obtained from the experiments, the details of which are given in the original communication :—

——	Quantity of the Explosive Required to Produce the Same Increase of Space.	Explosive Action in Comparison with Gelatine-Dynamite Taken as 1.
	Gr.	
Gelatine-dynamite	10	1.000
Carbonite......................	21½	0.465
Firedamp dynamite..............	17	0.588
Progressite....................	17	0.588
Westphalite....................	14	0.714
Dahmenite A....................	13	0.770
Roburite.......................	12	0.833

As regards carbonite and firedamp dynamite, therefore, the proportion is much more favorable than that given above. That progressite has given unfavorable results is due to the fact that the explosive used in the experiments, taken from another box, had, as shown by the third experiment, a lower explosive power than that of the sample used in the first experiment. (According to the notice on the package, however, the composition of the present sample was the same as that of the former). The results obtained from the remaining explosives do not greatly differ from the earlier results. If, in the case of these experiments, no more favorable figures were obtained, this circumstance is to be attributed to the slighter difference in the widening-out of the hole, and partially also to the above-named non-uniform composition of the explosives. Now, whether the figures thus found may be directly referred to practice cannot be asserted without explanation. It would, however, be interesting to determine the value of these figures by exhaustive experiments carried out in coal. An important circumstance must, however, be constantly borne in mind, with which the results obtained by the lead block, as also in practice, are intimately connected—namely, the various density of charge, or the specific weights of an explosive.

For the same weight a specifically heavier explosive occupies a smaller space than the specifically lighter. Accordingly a greater weight of the first-named can be charged into a shot-hole of determined length than of the latter; and therefore the explosive power concentrated in this length, in the case of the specifically heavier, is greater in proportion. It is especially in practice that this circumstance will be manifested.

By accurately weighing the original cartridges, it has been attempted to determine the density of charge of the various explosives, with respect to their length and diameter, and also the weight of the case, as compared with gelatine-dynamite, in order to calculate, with its assistance and the above-named shattering values (Brisanz-Zahlen),

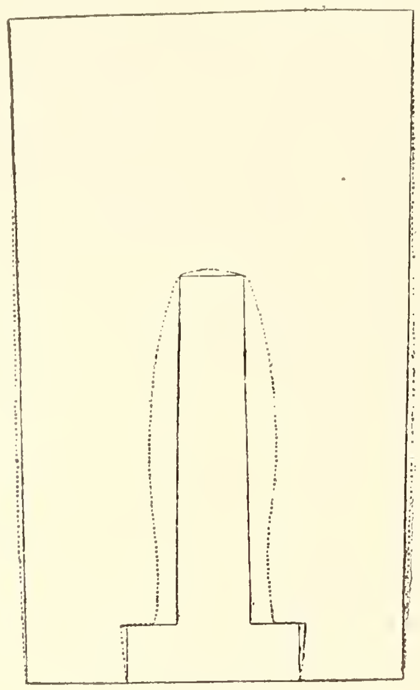


FIG. 5

that degree of explosive power which is developed in a given space, as compared with gelatine-dynamite. The following table gives the values obtained :—

—	In Comparison with Gelatine-Dynamite Taken as 1.	
	Weight of the Same Bulk.	Explosive Power of the Same Bulk.
Gelatine-dynamite	1	1
Carbonite	0.73	0.339
Firedamp dynamite	0.95	0.559
Progressite	0.60	0.353
Westphalite	0.55	0.393
Dahmenite A	0.53	0.408
Roburite	0.61	0.509

The figures of this table are partially confirmed by the fact that the safety explosives, firedamp dynamite and roburite, which give the highest values, are employed almost exclusively in 23 mm. or 25 mm. cartridges, while the others, on the contrary, are generally put up in 30 mm. to 40 mm. cartridges. Moreover, they show clearly why, with the use of safety explosives in stone drifts, and especially in cross-cuts, no favorable results have hitherto been obtained. In getting coal the proportions are naturally different; and here it will even be desirable, in most cases at any rate, to distribute the action of the explosive over a greater length of bore-hole.

NOVA SCOTIA NOTES.

The Northup gold mine, which was purchased some time ago by American capitalists and after a considerable amount of litigation finally abandoned as useless, has been re-opened by Mr. Clarence H. Dimock, of Windsor fame, one of the original owners. There have been two crushings, producing 100 and 104 ounces respectively. The mine is reported to be looking well, and is likely to become one of our staple producers.

The Modstock mine (which, by the way, appeared in our last issue as the Woodstock, through typographical error,) has had its first crushing under the new management, the result being 169 ounces of gold from 123 tons of ore; this represents 10 days' working.

We had a call from Mr. J. D. McGregor the other day. He informs us that the gold mine at Fifteen Mile Stream is looking very well. The last month's yield was 380 oz.; this, following 409 oz. for August, which we reported in our last, shows it to be one of the best properties in the province.

Mr. R. McLeod brought in a brick of 173 oz. from the Caribou Gold Mining Co. (Ltd.) property at Caribou. This represents the September crushing; the August crushing yielded one ounce less.

Mr. Andrews reports the Richardson mine to be still doing well. This is a low grade property. A large belt is being worked at a fairly small cost.

William McLeod, a miner working in the Victoria coal mine, C.B., was killed on the 15th of October. He went down in the pit to his usual work and had only just started when a fall of coal occurred, killing him instantly.

We notice that letters patent have been granted, incorporating the well-known firm of I. Matheson & Co. The provisional directors are William Grant Matheson, James Carmichael McGregor, and James Matheson Carmichael.

A special general meeting of the Mooseland Gold Mining Co. has been called. There is a motion on the agenda for winding up the company.

A general meeting of the Dominion Smelting Co. has been called to consider whether the development which has been carried out on their property at Smithfield is sufficiently encouraging to warrant a further call on the shareholders.

The Coxheath copper mine and plant, including air compressors, rock drills, etc., has been sold by the sheriff, for $5,100, to Mr. Isaac P. Gragg, one of the former members of the company.

The New Glasgow *Chronicle* has the following item:—" We understand that Mr. James A. Fraser has purchased a gold mine in Country Harbor, consisting of 96 areas. The mine is said to be a valuable one; the formation of the rock is different from any other mine discovered in the province, the walls being of granite. The same company who constituted the New Glasgow Gold Mining Co. are owners of the new mine.

The Dominion Coal Co's new pier at Louisburg is finished. It is one of the most magnificent structures of its kind on the continent, and the company will now be able to ship all the year round.

Editorial matter of a mining nature must be at a very heavy premium in Halifax just now. The *Critic* has a leader in its last issue in reply to our comments respecting their remarks on the " South Kensington School of Mines." The following paragraph is sufficient to show up the whole editorial. " Metal mining is a comparatively easy matter, but with coal it is different, and it is not possible for a graduate of any mining school, who has not had at least five years' actual hard work about a coal mine, to call himself a coal-mining engineer."

The *Critic* has fallen into the popular error that any fool may manage a metal mine. They don't appear to grasp the fact that, because the product of a metal mine is more valuable than the product of a coal mine, it will more easily stand mismanagement.

The *Critic* finishes its editorial by saying they have no desire to run down the School of Mines, yet in the earlier part of it they try to bolster up their previous rotten theory. The logic of the whole article forcibly brought back to our memory a verse we learned in the days of our youth. It runs thus:

" When a man who turnips cries,
Cries not when his father dies,
'Tis a proof that he would rather
Have a turnip than a father."

The many friends of Mr. A. M. Evans, M.E., formerly in charge of King Bros' Asbestos mine and for the past two years manager of the Dominion Coal Co's Gowrie mine, will be pleased to learn that he has been honorably acquitted of the charge of manslaughter arising out of the death of a brakeman on one of the company's coal trains. A. M. is now having a shy at the coroner for false arrest, the claim for damages being placed at $5,000. We wish him luck.

The returns from the Modstock mine for the month of September were 259 oz. o gold.

J. C. McDonald, the late manager of the Modstock mine, has purchased a property to the south of that mine for $15,000. There is a considerable amount of grumbling amongst the mine owners at the roads in this district, which are in a disgraceful state and considerably handicap the industry.

The Richardson Gold Mining Co. have purchased an additional 20 stamps, and will erect them at once, thus making their present mill into a 40-stamp one.

The Golden Lode mine produced 224 oz. of gold last month from about 22 tons of rock crushed.

With the exception of the General Mining Association, it is reported that the Cape Breton collieries are behind in their output compared with last year.

There has been extensive prospecting by various parties at the head of Lingan Bay, and it is expected that the result will be an extension of the coal field.

The Burchell Bros., at New Campbellton, who have been boring some time for it, are reported to have found the celebrated Sydney mines seam on their property.

The North Sydney Mining Company has completed a small pier and is ready for shipments.

The Intercolonial Coal Company's new coal-washing plant is in place.

The furnaces at Londonderry and Ferrona are running steadily. The Nova Scotia Steel Company is equipping its red hematite property at Belle Isle, Newfoundland, with working plant and will soon be shipping to its furnace at Ferrona.

The Montreal *Gazette* publishes a tabulated statement giving the amount of coal brought to that port from Cape Breton collieries during the month of September. The Dominion Coal Company landed 84,250 tons at Montreal in September and the General Mining Association 14,190 tons. A large number of the G. M. A. shipments for September were delivered at Quebec and of course are not included in the above.

Captain Isaac P. Gragg, of Boston, principle owner of the Copper mines, was at Coxheath, arranging for some improvements to the plant at the copper mines. It is reported that the owners intend broad-gauging the railway track to the Intercolonial at Northwest Arm. It is also stated that work at the mine is to be vigorously prosecuted, as new life and capital has been secured.

The General Mining Association of London, Ltd., purpose constructing a piece of railway to run in a parallel direction from a point near the old pit to connect with the main line near No. 3. The movement is seemingly to avoid the heavy grades of the present line and the difficulties to contend with during the early winter season caused by heavy snow blockades.

MINING IN BRITISH COLUMBIA.

From a friend who has just returned from Trail Creek, we were glad to hear of the success of our old friend, J. D. Sword, of the Ingersoll Rock Drill Company of Canada. J. D. has been vigorously pushing the interests of the Ingersoll Company and has secured the plums of this year's business in the new camps. J. D's a rustler. "*He is!*"

Mr. W. Pellew-Harvey, F.C.S., is putting up a very complete assay plant at his laboratory in Vancouver. When finished the works will contain, besides the usual furnaces, a chlorination plant, a stamp mill, and a one-ton water-jacket smelting stack.

The cave of a slab of gravel in the Cariboo mine at Quesnelle Forks this month caused serious but not fatal injuries to five men, Messrs. D. McRae, Joe Dunn, Brown, McNorton and another. The bank of gravel, which is about 300 feet high, was considered dangerous, and the sluice boxes near it were cleaned up only a short time ago. A watchman was on duty to give warning, while the men were at work blasting boulders in the pit. He gave warning in good time, and the gravel fell in such a way that would not seem to carry danger with it, but when it struck the bottom the mass broke up and slid outward to where the men were standing in apparent safety. They were badly bruised and knocked around. One man had his legs broken and another an arm, while McRae had his back severely injured. A surgeon was sent for and at last reports the men were as comfortable as could be expected.

The shipments of ore from the Trail Creek and other mines from June to the end of September, were as follows:—

	Tons.
Nelson	214½
Ainsworth	190
Trail Creek (gold ore)	8,748¼
Slocan *via* Nakusp	945
Slocan *via* Kaslo	16½
	10,114¼

The shipments of bullion during the same period were 1,160 tons. The shipments from this district from the beginning of the year amount to 21,928 tons of a value of $1,780,400.

The Omaha & Grant Smelting Co., acting through their representative, have bonded the Ruby Silver from W. P. Russell. Geo. Clarke, late superintendent of the Washington, is in charge. The price is reported to be $7,500. The same company has bonded the Ajax and Treasure Vault claims, situated near the Noble Five.

The Stevenson Gold and Platinum Hydraulic Mining Company is getting along well. About a mile of flume is built, while the grading and trestlework is about half a mile further ahead. The company purposes bringing in the first north fork of Granite creek, and this will give about 1,000 inches of water. When Mr. Hunter left Indians had been sent to pack the pipe to the grounds. This company has been reorganized under Dominion charter, with the name of Granite Creek Gold and Platinum Hydraulic Co., Ltd., and the affairs will soon be nominally transferred. Washing is expected to start in the spring.

"The site of the smelter for the Silver King mine," says the *Tribune*, "is a scene of activity. Ore bins are being erected, and excavating for the foundations of the smelter is being pushed; the railway spur is being graded and trestles built, and the tramway is almost completed. Men are shovelling earth, breaking stone, framing timbers, and bossing. In all, about one hundred men are employed. Most of the rockwork on the railway spur is completed, and foreman Kelly will soon have his men on the big side-cut on the bluff to the north of the smelter site. A bridge gang under the foremanship of Jake Serson is erecting the big trestle opposite the railway round-house. The ore-bins are going up under the foremanship of Hugh Nixon. The excavations for the smelter buildings are being looked after by superintendent Johnson himself, with Mr. McIntyre as foreman. The tramway is under the control of the California Wire Works Co., of which E. I. Parsons is superintendent here. It is said that the smelter will be in operation by January 1st."

Mr. J. Kirkup, mining recorder and deputy gold commissioner of the Trail Creek district, states that there were about 500 claims recorded previous to his taking the office on the 20th of March of this year. Since that time 1,561 claims have been recorded and that there have been 650 to 750 transfers and bonds, 150 certificates of work and 25 applications for a Crown Grant.

The coal shipments for the month of September show an increase over August, being as follows:—

	Output. Tons.	Increase. Tons.
New Vancouver Coal Co.	17,233	7,907
Wellington Coal Co.	20.264	7,338
Union Colliery Co.	18,179	7,429

The Montana Ore Purchasing Co. of Butte City, Mont., is proceeding with the construction of the smelter at Trail. The *Trail Creek Miner* reporting on the work says: The equipment of the smelter is to be very complete, and of the most improved kind. There are to be two O'Hara furnaces, two reverberatory furnaces, circular furnace designed expressly for these works, and one water jacket stack. These comprise the essential features. There will also he very complete sampling works. The necessary adjuncts in the way of buildings, ore sheds, etc., will be of the most complete order. Mr. Heinze knows how to build a smelter. He has one in Butte which cleared nearly $100,000 last year and which is admirable in all its arrangements. The Trail smelter will accommodate about 125 tons of ore per day. Mr. Heinze has a contract with the Le Roi for 75,000 tons. This will be delivered to him probably at the rate of 100 tons a day or 36,500 tons a year. Therefore it will take at least two years to discharge this contract. Since he will have a capacity of twenty-five tons a day above the Le Roi ore it may be asked how is he to take care of the other ore which is to be offered from this camp. To this question he says he will double the capacity just as soon as it shall appear to be an actual necessity.

It is reported that the smelter at Golden is to be dismantled and the machinery and such other portions of the plant as are of utility will be removed to Midway, B.C., where a syndicate, represented by S. S. Fowler, M.E., of Chicago, and W. T. Thompson, of Fairview, will erect a smelter with a 50 ton plant.

J. S. Bell reports considerable activity in mining matters in Lillooet district. At the Bonanza mine there are already 500 tons of ore on the dump. Work is to be renewed shortly on the Vancouver Enterprise placer claim on Cayoos creek. Twenty-five men are at work for the Bridge River Gold Mining Company at Horseshoe Bend. New quartz stakes have been set on Anderson lake. An English syndicate is to run a $40,000 ditch to bring water from Cayoos creek to the McDonald & Hurley placer claims on the east bank of the Fraser.

Men employed at the Tam O'Shanter, on Kootenay lake above the Blue Bell, have been clearing up around the mine, and sorting the ore, with the result that about 30 tons are ready for shipment. Repairs have also been made to the wharf. Next week the force will be largely increased, another tunnel run for about 200 feet, and the mine worked for all it is worth. The property is said to be a promising one, and under efficient management should be made profitable.

The owners of the Washington mine, Slocan district, have asked for estimates on a 60-ton concentrator and a 1,500-foot tramway for that property. It is the intention to run the concentrator by water-power, the water supply coming from what is locally known as McGuigan lake. The contract will probably be closed next week.

The War Eagle Company at Trail Creek has mined and shipped 7,015 tons of ore to date. The last 27 shipments, amounting altogether to 2,300 tons brought an average return from the smelter of $48.30 per ton. From this must be deducted $10.50 for freight and treatment, $2 per ton haulage to Trail, and $4 for mining, leaving a net profit of $31.30 per ton. A new tunnel is now being run in from below to tap the vein, which it is expected to reach in 1,800 feet. Two new boilers of 100 horse-power each are under order and are expected to arrive shortly. They will be used for driving from 10 to 12 drills.

MICA NOTES.

We are indebted to the Bureau of Statistics, Treasury Department, Washington, for the following returns of the imports of mica into the United States for the fiscal year ended 30th June, 1895:—

	Lbs.	Value.
France	1,315	$ 481
Germany	1,544	1,999
England	110,491	33,979
Scotland	359	207
Canada	546,905	36,401
British East Indies	148,056	48,731
Japan	12,000	2,194
British Australasia	312	292
Total for 1895	820,982	$124,284

NOTE.—The imports from England and Scotland are most likely entirely Indian mica. That from Canada is entirely from the Province of Quebec.—ED.

The imports for previous years by the United States were as follows:—

Mica and Mica Waste.

1884—Free	$28,284	1888—Free	$21,013
1885 "	28,685	1889 "	93,143
1886 "	43,107	1890 "	161,740
1887 "	63,480	1891 "	110,094

Mica.

	Lbs.	Value.
1891—Duty 35%	130,029	$21,750 01
1892 "	1,047,404	179,865 12
1893 "	930,707	214,679 99
1894 "	514,132	84,429 55

At the Wallingford mine, in East Templeton, the owners are working a small force and laying up stock. The mine is being carefully and judiciously worked, and by no means to its full capacity. During the past season a steam hoisting plant was added. About six or seven tons of large mica of an excellent quality, ranging from 4 in. x 6 in. and upwards were on hand at the date of our correspondent's visit. Rumor has it that an English syndicate have made an offer for the property.

At the Vavasour mine, Cantley, mining is being steadily carried on with returns satisfactory to the owner. The quantity and quality of the output has been up to the standard of the past three years, which is saying a good deal. An addition to the cutting shop at the mine was recently made.

The Phosphate King mine, Templeton, owned and operated by Mr. T. J. Watters, is producing mica of excellent quality, and the deposits are reported to be steadily enlarging as the work progresses. Steam drills and hoist are in operation here.

The old Blackburn phosphate mine, Templeton, under direction of Mr. H. C. Baker, Ba. Sc., a recent graduate of McGill, is being steadily worked for mica, the bulk of the product being obtained from a pit down 180 ft.

McLaurin mine, East Templeton. A small gang is employed here and a good quality of mica is obtained. The pit shows crystals cropping out bottom and sides.

The Falardeau mine, East Templeton, together with all the lands and property of the Canada Industrial Co., has been acquired by American people. Two pits operated by steam drills are worked. At last report it was the intention to move the working plant to another portion of the property.

The Canadian Mica Co. has acquired the following properties :—

Chubbick lot, Wilson's Corners, Que.
Mulvahill lot, Cascades, Que.
Perth lot, Burgess, Ont.

Work will be commenced on these properties at once. At the Dacey property, Cantley, a force of 18 men are employed night and day shifts, producing mica for shipment to England. The output is reported to be satisfactory as to size and quality. The Brown lot at Cantley, recently acquired by the company, is also being opened up, a small force being employed. At Murray Bay, the company's properties will be worked all winter.

A correspondent writes : "The demand for mica for electrical purposes is steadily growing, the bulk of the Canadian product going to the United States for consumption by street railways and manufacturers of electrical machinery. A notable feature, too, is the attention our Canadian amber is receiving in England and Europe, there being a very marked increase in the shipments to those countries.

"Prices for Canadian have not been very satisfactory to the producer, the average sales realizing but a comparatively small margin of profit when the uncertainty of many of the deposits and the necessarily high cost of mining and dressing is considered. The mica pedlar, too, is a growing nuisance and should be suppressed. He is generally some small farmer, owning a stump and rock farm in our mining country, who finds a small show of mica, and retails the crystals much in the same way as he does his cabbages and turnips. His prices vary. In the morning his mica is worth about $1 a pound ; no takers ; about noon he is hungry and his price drops to 50 cents per pound ; still no takers ; about 4 o'clock it is time to be on the homeward tramp and the mica drops to 10 or 15 cents per pound and is generally purchased by one of the consumers who holds his purchase over the regular miner and dealer and tells him how cheaply mica can be bought."

The last pack-train to Kamloops brought 1,500 pounds of mica from the Tete Jeune Cache mines, Canoe River district, B.C., operated by Mr. J. F. Smith, of Kamloops. This shipment is reported to be excellent quality, large enough to furnish clear sheets squared to 12 x 18 inches, and should bring good prices.

One of the features of the exhibition in connection with the recent Street Railway convention at Montreal was the display of micanite by the American Insulating Company. There were also one or two exhibits of the product of our mines, but when the consumption of the mineral by the electric street railways, particularly in the United States, is considered, it seems that our mica miners should have made a much better representation. The Mining Bureau at Quebec and the Geological Survey also should have been represented. A golden opportunity was missed of extending the mica trade of the country by this oversight.

ASBESTOS NOTES.

The Journal of the Imperial Institute in a recent issue gives some information to its readers respecting the Canadian asbestos industry from which one would gather that the output of the mines had declined. This impression is entirely erroneous there being during the past two years a very marked activity in the production of this mineral. The production in 1880 amounted to but 380 tons, valued at $24,700, while in 1890 it had reached 9,860 tons, of a value of $1,260,240. Since then the shipments from Thetford, Black Lake and other stations on the line of the Quebec Central Ry. as per official returns furnished to the REVIEW were :

	lbs.
1891	14,672,180
1892	8,674,560
1893	10,677,900
1894	14,683,055

These figures do not include important shipments *via* the Grand Trunk Railway from the Jeffrey mine at Danville, or the exports from Ottawa County, Quebec, and Hastings, Ont. We are glad to see that a number of our companies have sent exhibits to the Institute, for the permanent collection, but the list is far from complete. Canadian operators who have an eye to extending their trade relations with the mother country, will find a good representation of their various grades at the Institute a remunerative advertisement.

Mr. F. Cirkel, M.E., Ottawa, has a force at work culling the dumps of property formerly owned by the Templeton Asbestos Co., and is meeting with fair success.

The International Asbestos Co. of Newark, N.J., has been working steadily all summer on their property in the Township of Low, Ottawa County, and the shipments are reported to average about 75 tons per month. The mineral produced, though short in fibre, is of very fair quality.

Mr. A. W. Stevenson and Mr. R. T. Hopper were in Templeton the other day making arrangements for the opening up of the promising show of asbestos on the Stevenson property.

From the Eastern Townships mines there is nothing very worthy of note. The usual quantity of asbestos has been moving, and the principal mines have worked steadily throughout the season, that is to say, Bell's, Johnson's, King Bros., Anglo-Canadian and United. The American Company at Black Lake has simply had a few men working on contract in a quiet way, while the Beaver Company has remained closed down entirely, many being of the opinion, for diplomatic reasons. The Ross-Ward and Glasgow and Montreal mines have also been closed. There appears to be an increase in the consumption of asbestos and the trade is steadily reviving although prices are still far from being as good as the producers would like.

The Anglo-Canadian Asbestos Company will continue work throughout the winter. On this property a very promising deposit of chromic iron has been uncovered, extending over an area of two or three acres, and a considerable quantity of the mineral is being mined.

Messrs. W. T. Costigan and others have been doing considerable grinding of short-fibred stuff at their Montreal works. Their improved "Cyclone" mills, quite a number of which have been sold to the mining companies, are proving an excellent separator, and save large quantities of material that in former years went to the dumps.

The Danville Slate and Asbestos Co., as mentioned elsewhere, are pushing the development of their Jeffrey mine with great activity, a force of some 400 men finding employment in their various enterprises. The property has been thoroughly equipped with a first-class plant and the output of mineral is considerably larger than in former years.

GOLD MINING IN QUEBEC.

Mr. Chalmers of the Geological Survey, who has spent the summer in an investigation of the surface geology of the Quebec gold fields, is reported to be greatly impressed with the possibilities of succesful mining in the old river beds of the Chaudiere and other localities. He also reports the discovery of quartz veins containing gold at Dudswell as authentic.

Mr. John Hardman, S. B., of Halifax, for many years associated with the Oldham, West Waverly, and other successful gold mines in Nova Scotia, has commenced work on his property at Slate Creek near St. George's. Capt. George MacDuuff an Australian miner with many years experience in quartz and alluvial mining in the antipodes, is in charge of the work of exploiting the property.

Milling Arizona Gold-Ores with a "Colorado" Stamp-Mill.

By WILLARD S. MORSE, Prescott, Arizona.*

Referring to Mr. Rickard's paper on "The Limitations of the Gold Stamp-Mill" (*Trans.*, xxiii., 137), and the discussions that have followed, and without entering into any controversy as to the relative merits of the "California" and "Colorado" types of stamp-mills, I wish to give the results obtained on ores from Lynx Creek district, near Prescott, Arizona, with a stamp-mill of the Colorado, or, more precisely, the Gilpin county, Colo., type.

The mines of the district have been worked for nearly thirty years, yet in that time very little, if any, work has been done on the veins below the line where the oxidized or "free" ores end, and the sulphide or "base" ores come in, except in a few cases where the sulphide ore was high enough in value to ship to smelters. The surface or oxidized ores have been worked in arrastras and stamp-mills, but few attempts have been made to mill the so-called "base" ores. About thirteen years ago a smelter was built in the district by Mr. John Howell to smelt these ores, but was abandoned on account of the high transportation charges on fuel and bullion.

The saving shown in this paper is not claimed to be high, and the history of the district has been given to show that heretofore, at least, the ores have not been considered suitable for stamp-milling.

The ore from which the results are given was extracted from below water-line (100 to 250 feet from the surface), and is a quartz carrying zinc-blende, iron pyrites, galena, and a small percentage of copper and arsenical pyrites.

MILL.

The mill is a typical "Gilpin County" stamp-mill of 10 stamps. No rock-breaker or self-feeders are used, the ore being fed by hand. I do not wish to be understood as advocating this method of feeding. It was adopted as a matter of economy in the first cost of plant, as the attempt to mill these ores was regarded as an experiment, in view of the history of the district.

The weight of stamps when new was as follows :—

	Pounds.
Stem	265
Tappet	35
Head	225
Shoe	85
Total	610

The stamps dropped 15 inches, 36 times per minute, in the following order : 1-5-2-4-3.

Fig. 1 shows a section of the mortar.

* Trans. Am. Inst. of Mining Engineers.

The mortars are provided with copper amalgamating-plates, the front plate being 5 inches, and the back plate 10 inches wide. Both plates extend the full length of the mortar, and have an inclination of 45°.

The outside plates (one for each battery of 5 stamps) are 96 by 52 inches, silver-plated (1 ounce to the square foot). These plates are set with an inclination of 1⅝ inches to the foot.

CONCENTRATORS.

For concentration of the tailings after amalgamation, two Gilpin county bumping or percussion tables are used. The beds of these tables are made of cast-iron. The cam-shaft of the table is run at 78 revolutions per minute, giving the table 156 strokes or bumps per minute.

CALCULATIONS.

The calculations presented are based on the following data:

Tailings.—A sample of tailings running from the mill is taken every half-hour by diverting the entire stream of tailings through a swinging trough, which discharges into a galvanized iron tub. This trough is operated by a cord from the battery. The sample thus collected, containing the proper proportions of slimes and sands, is decanted after completely settling and evaporated to dryness. Two such samples are made daily and assayed, and the results given below are the average of 503 samples and assays.

Concentrates.—The weights, assays, and analyses of concentrates given are from smelter-returns.

Bullion.—United States mint returns are used for contents of bullion.

Ore.—The assay-value of ore has been determined by calculation based on the weight of ore and concentrates and the contents of bullion, concentrates and tailings.

RESULTS.

The following are the results obtained from the milling of 2,432.9 tons of ore of an average assay-value of 0.763 ounce of gold per ton, which varied in a monthly run from 0.574 to 1.18 ounces per ton:

Amalgam.—Total amalgam recovered, 5,711.6 ounces. Of this, 70.2 per cent. was from inside battery plates, and 29.8 per cent. from outside plates.

Retort.—Weight of retort, 2,024.45 ounces, or 35.4 per cent. of weight of amalgam.

Bullion.—Weight of bar, 1,854.38 ounces. Loss of weight in melting retort, 8.4 per cent. Assay of bullion, gold, .636 fine. Contents of bullion, gold, 1,180.148 ounces.

Concentrates.—Net weight of concentrates, 605.149 pounds avoirdupois, or 12.4 per cent. of weight of ore. Assay and analysis of concentrates, Au, 1.347 ounces per ton; Ag, 6.93 ounces per ton; Pb, 6.34 per cent.; SiO_2, 9.9 per cent.; Fe, 30 per cent.; Zn, 6.85 per cent. Contents of concentrates, 407.6972 ounces of gold.

Tailings.—Weight of ore, 4,865,822 pounds; weight of concentrates, 605,149 pounds; weight of tailings, 4,260,673 pounds. Assay of tailings: Average of 503 samples and assays, 0.1271 ounces of gold per ton. Contents of tailings, 270.8327 ounces of gold.

Calculation of Saving and Loss.

—	Ounces Gold.	Per cent.
Bullion	1180.1480	63.5
Concentrates	407.6972	21.9
Tailings	270.8327	14.6
	1858.6779	100.

The highest results obtained by amalgamation was on a lot of 332 tons, assay-value of ore 1.134 ounces of gold per ton, which was:

	Per cent.
By amalgamation	76.3
In concentrates	14.1
Lost in tailings	9.6

Sizing of Tailings and Concentrates.

Mesh of Screen used on Battery.	Material.	Coarser than 60-mesh.	Through 60-mesh and remaining on 80-mesh.	Through 80-mesh and remaining on 100-mesh.	Through 100-mesh and remaining on 150-mesh.	Through 150-mesh and remaining on 200-mesh.	Finer than 200-mesh.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
30	Tailings	5.4	3.9	15.6	12.3	11.0	51.8
30	Concentrates	2.8	2.4	7.8	16.	19.4	51.6
40	Tailings	6.6	5.	10.8	13.6	6.8	57.2
40	Concentrates	1.9	1.1	5.9	16.5	22.1	52.5
60	Tailings	......	2.	3.	14.5	9.5	66.
60	Concentrates	......	2.	3.4	10.4	20.	58.2

Tests made by panning weighed quantities of tailings and weighing and assaying the concentrates thus recovered, showed that about 60 per cent. of the gold lost in tailings could be accounted for in this way. The concentrates thus saved, however, invariably assayed much lower than the average of the concentrates that were saved on the concentrating-tables, and were very fine, 90 per cent. passing through a 200-mesh screen.

Sized samples of concentrates, each size assayed separately, invariably show that the finer concentrates assay less than the coarser sizes.

The following results on a sample of concentrates assaying 1.8 ounces of gold per ton will serve as an illustration of one of many such experiments that have been made:

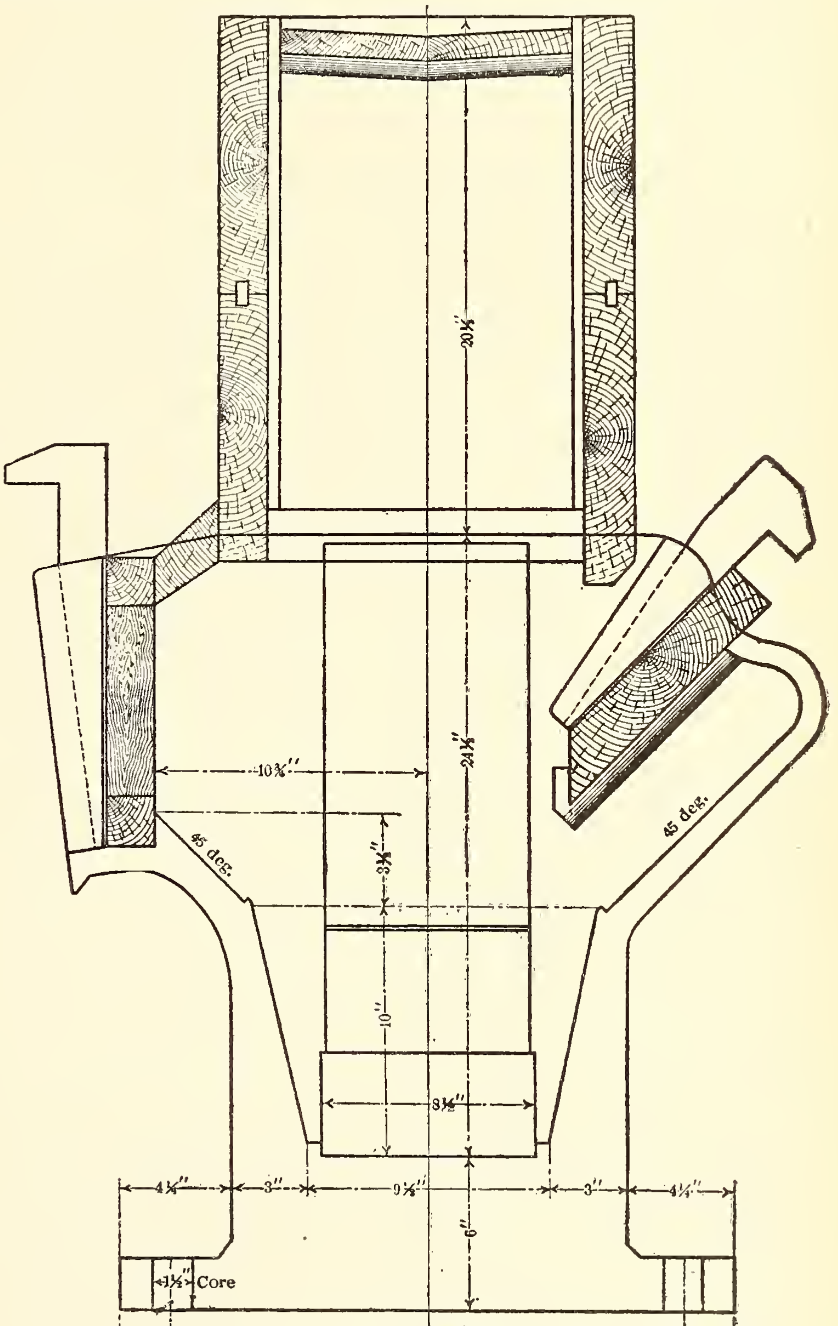
Sise and Assay of Concentrates.

Size.	Assay. Ounces Gold per ton.
Coarser than 60-mesh	2.6
Through 60-mesh, remaining on 100-mesh	2.2
Through 100-mesh, remaining on 150-mesh	2.2
Through 150-mesh, remaining on 200-mesh	2.
Finer than 200-mesh	1.5

CONCLUSIONS.

From more than 80 assays made on specimens of the various characters of ore found in the district, the following conclusions have been arrived at:

1. That the gold is contained in the quartz and "free," or else is associated with the iron, copper, or arsenical pyrites, and that a large percentage of that, associated with the pyrites, can be extracted by amalgamation with very fine crushing.



SECTION OF MORTAR.

2. That the zinc-blende, as a rule, carries very little gold value, and that in cases where any considerable quantity of gold has been found in the blende, it was very "free," and easily extracted by amalgamation after fine crushing.

3. That the galena, as a rule, assays low in gold and high in silver.

NOTES.

Screens.—40-mesh burr-slot screens are used as a rule, and last about three weeks.

Shoes and Dies.—Cast-iron shoes and dies are used, and the actual wear of iron per ton of ore is: for shoes, 1.122 pounds; for dies, 0.692 pound.

Crushing-Rate.—The average crushing-rate of the mill for nine months, based on actual running time, is 3,335 pounds per stamp per twenty-four hours.

Water Used in Battery.—Water used in the battery, 21,000 gallons per twenty-four hours, or 1,252 gallons per ton of ore crushed.

RESULTS ON ORE HIGH IN ZINC.

The results on a small lot of ore selected for high zinc-contents may be of interest. The assay and analysis of the ore are calculated from contents and analysis of concentrates and tailings, weight of ore, and concentrates and contents of bullion.

Ore.—Assay-value of ore, 1.393 ounces of gold per ton. Analysis, Pb, 2.90; SiO_2, 59.0; Fe, 8.8; Zn, 9.7 per cent.

Amalgama ion.—The ore yielded by amalgamation 0.9 ounce fine gold per ton.

Concentrates.—One ton of concentrates was made to 3.8 tons of ore. Assay and analysis of concentrates: Gold, 1.54 ounces; Pb, 7.4; SiO_2, 9.8; Fe, 21.6; Zn, 19 per cent.

Tailings.—Assay and analysis of tailings: Gold, 0.12 ounce; Pb, 1.3; SiO_2, 76.6; Fe, 4.3; Zn, 6.5 per cent.

From the above data the following calculation is made:

——	Contained in Bullion.	Contained in Concentrates.	Contained in Tailings.
	Per cent.	Per cent.	Per cent.
Gold	64.5	29.1	6.4
Lead	...	67.	33.
Zinc	....	51.	49.
Iron	....	64.2	35.8
Silica	....	4.4	95.6

Distribution of Power in Collieries.

By Llewelyn B. Atkinson, A.M.I.C.E.*

The present position of the coal mining industry in the United Kingdom is one deserving of the most thoughtful consideration by all who are interested in the future commerce of the country, and the object of the present paper is to point out how some of the difficulties under which this industry at present labors may possibly be met. The difficulty to be contended with at present may be briefly stated. The possible output, indeed the output at which a reasonable profit can be earned, is greater than the demand at present prices; and even this demand is threatened by the decreasing price of foreign coal. From whatever point of view it is looked at, the question resolves itself into stimulating demand, and this can only be effectually done by lowering the selling price, which cannot at present be done without extinguishing the profit.

To decrease the cost at the collieries there are broadly three courses:—

(1) To decrease the payment per ton to the mineral owner.

(2) To decrease the wages cost per ton raised.

(3) To decrease the fuel expenditure per ton raised.

The first of these is a matter outside the scope of this paper, the second will be briefly touched upon, and the third will be dealt with in some detail.

In the course of the last eight or nine years the author has been in close contact with mining operations in various parts of England and Wales, and the opinion has gradually been forced upon him that there is a very large margin of economy in wages and fuel to be effected. This arises from the fact that economies in labor and fuel which are studied and insisted on in engineering and manufacturing industries are hardly considered in coal mining, at all events in the majorfty of instances. This broad fact mnst appeal to every mind that, whereas in almost every manufacturing process or industrial operation the product per man has been nearly doubled and the consumption of fuel been halved within the last fifteen years; in coal mining the product per man has been practically stationary, and the cost of fuel per ton raised probably nearly so. This is frequently attributed to the stringency of mining legislation, but legislation has largely affected other industries also, and the results cannot be altgether attributed to this cause.

It would be a long task to enumerate the causes which, in the author's opinion, contribute to this result; but, broadly, it appears to him that what is required, is to do in mining what has been done in every other department of industry, and to lower the cost of wages and material per ton by increasing the product per man and per pound of fuel by the following means:—

(1) Improved organization, both in the working, and more especially in the original laying out of the scheme of working a colliery.

(2) More superintendence and supervision underground by thoroughly well informed mining and mechanical engineers.

(3) The greater use of mechanical power instead of human and horse labor, and a more economical production of that power.

In short, substitute brains and mechanical power for human labor.

It has been already stated that the immediate object of this paper is to deal with the question of the economical production of power, but a few remarks on the subject of mechanical power in collieries may be useful.

The getting of coal resolves itself into cutting and filling and hauling to the pit bottom.

In the great majority of collieries both cutting and filling are done without using any mechanical power whatever, and the progress made in introducing mechanical coal cutters is slow, at all events in this country. A considerable experience extending over some years with coal cutting machines in various collieries and various parts of the country justifies the author in saying that there are hardly any seams under 3 ft. 6 in. in thickness that could not be more cheaply worked by mechanical coal cutters than by hand labor, and with a better product of round coal, but that in probably not 5 per cent. of the collieries of the country is the existing organization of the filling and haulage sufficiently good to enable machines to be worked with that regularity which will make them pay.

This is the secret of the otherwise unexplained fact that some few collieries have been and are worked by machinery with marked success, whilst the reverse holds good of the majority of cases in which it has been tried. Organization and superintendence, those are the only secrets of success in cutting coal by machinery; till they are forthcoming, mechanical assistance in this direction must be postponed.

In thin seams much might no doubt be done to apply mechanical power to reduce labor and breakage in filling the coal, but the same remark applies as to coal cutting.

The use of machinery in the coal face would so much reduce the length of face under work for a given output that the roads on to the face being less in total length, could without increased cost be kept in a condition enabling mechanical haulage to be used right up to the face, doing away with horses and ponies altogether. There are some of the directions in which mechanical power may be looked for to profitably enable the output per man to be increased. But before this can be done much will have to be done to improve the general organization both above and below ground. And this may well be commenced by the economical laying out and conduct of the arrangements for the generation of power above ground.

Consider the conditions under which this is at present carried out.

Generally speaking, when sinking operations are completed, a winding engine is put down. Subsequently as the workings extend, haulage is considered, and some plant, either steam, compressed air, or electrical, is provided for this. Later, perhaps, pumping becomes necessary, and again a plant (perhaps on another system) is put in. There are various engines at the surface for the screening, repairing-shop and other purposes. All these are of uneconomical types; so there ensues, at every point, waste of heat, waste of steam, particularly when, as in some cases, separate boilers are put down for each plant. And the answer to any criticism generally takes the form: "Oh, fuel is so cheap at a colliery that it does not matter." Why is the fuel so cheap, that is, of such low value? Because it is so small—smashed in hewing, smashed in filling, smashed on the screens, due to imperfect methods and appliances at every point. But, at any rate, it is worth at least 2s. 6d. per ton, and it is generally estimated that from 5 per cent. up to even 10 per cent. of the total output by weight of the collieries is consumed at the surface, and this means, even taking the lower figure, about 9½ million tons, worth about £1,190,000 per annum.

It has been stated by Mr. Foster Brown,* that the probable consumption of coal in colliery engines, taking an average, would be not less than 6 lbs. per h. p. hour. Taking this to refer to indicated horse-power, it is possible to produce the same power with 1½ lbs. of coal, or even less, hence it may be fairly said that there is a possible saving to be effected of 75 per cent., worth annually nearly £900,000. It would probably be well within the mark to say that the saving to be effected in labor of handling and in the maintenance of boilers and appliances for consuming this, would be worth, in addition, say 65 per cent. of the above sum, showing a possible economy of, say 1½ millions sterling per annum, a sum equal to over 2 per cent. on the total value of the coal raised, or about 3¾ per cent. of the whole wages annually paid in the mining industries; and if the coal were raised unbroken, so that its value was equal to the average value of the coal sold, these figures would rise to 3 per cent. of the value of the total coal raised, or 6 per cent of the wages paid.

It may be stated at once that to realize these economies the power required must be produced by compound or triple expansion condensing engines, appliances almost unknown in colliery work, and to do this there is no doubt that the whole power required at the colliery must be produced in one or, at most, two engines, and distributed with as little loss as possible to the points where power is required. There are various methods of distributing power, but some of them are only applicable to particular cases, or in particular circumstances; the only two of general applicability are compressed air and electricity.

Of these, whilst under favorable circumstances compressed air can be made to give a favorable efficiency, its application in mining is discounted by two important considerations of economy. To utilize compressed air with efficiency—(1) The pipes must be free from leakage, (2) the air must be heated before being used. These two conditions are practically unrealizable, and hence the efficiency of air transmission in collieries is and must necessarily be low. The cost of plant and extended air mains is also high.

The advantage, therefore, in point of view of first cost and efficiency as a means of distributing power rests with electricity, the economy of the cables compared with air mains, and the facility for extension and alterations to the position of the machinery make electricity an ideal means of distributing power.

There is, however, a question to which I must refer—viz., that of safety. This question of safety is one which has, from the first introduction of electricity in mining, been prominently before engineers; though it may be noted that among those who have had practical experience of its use in mines the objection is rarely raised. In a paper read in 1891 before the Institution of Civil Engineers by the author, in conjunction with Mr. C. A. Atkinson, this question was somewhat fully dealt with, and certain conclusions were arrived at which time and experience have gone to confirm, but, as this question is to some minds still an open one, and as additional experience has added to the knowledge of the subject, it may be well to deal with it again at some length.

There are two distinct questions:

(1) The safety of an electric motor, which may spark at the commutator.

(2) The safety of a system of cables, which may be ruptured while carrying an electric current.

Dealing with the first of these, it has been shown from theoretical considerations and by practical test that the amount of sparking which exists with electric motors of good construction is unable to ignite firedamp, owing to the fact that the temperature is never sufficiently high, and it is only therefore in exceptionally abnormal circumstances, such as a brush falling out of its holder or becoming displaced absolutely on the commutator, that the inflammation of firedamp can be effected; and it has also been shown conclusively by experiment that there are in the market methods of enclosing either the whole machine or the armature and commutator, or the commutator alone, which, even under these abnormal circumstances, entirely prevent either the access of firedamp or the ignition of firedamp outside the machine.

Practical experience is in accord with the experiment and with the principle named, and the author knows of no recorded instance where there has been an accident from the use of an electric motor in a coal mine. In connection with this, reference may be made to the question of commutatorless motors worked by multiphase alternate currents. As the principles on which these motors work are little understood, the author has appended to this paper some notes on the subject; but a few points are especially worthy of consideration. The first is that although such a motor may have no commutator, if it has to be regulated as to speed, or to start with the load on, it must have brushes and current collecting rings, in which case the displacement of the brushes under abnormal circumstances may have in a modified proportion the same result as in an ordinary motor. Another circumstance in connection with such motors as at present constructed is that the maximum turning moment they will give has a limiting value, beyond which it decreases as the load increases, even although the current increases, and that at any other than the normal speed the efficiency rapidly falls. Curves are given (Plate 21) showing the maximum turning moments given at different speeds, and the efficiencies are shown. For comparison similar curves are given (Plate 20) for a motor in which the speed is controlled by varying the strength of the magnetic field, using continuous current. A further point is that with such motors the losses in the cables and the dynamos, which with continuous currents are proportional to the power transmitted, are not proportional in the case of alternate currents, whilst in addition, as 250 volts alternating will give the same shock as 500 volts continuous, which is generally treated as the maximum advisable in a colliery, the cables have to be of about twice the area of section for the same power; hence these various considerations contribute to this, that the advantage of such motors at full load and full speed are to be balanced against their disadvan-

*Paper read before the South Wales Institute of Engineers

* See Address, British Association, Mechanical Science Section, 1891.

tages at less than full load and at other speeds, and in the particular case of colliery transmission these points are large factors.

Returning now to the second point in the question of safety, viz: the possible breakage of a cable. This may be at once overcome if the cables are buried below the surface, but as this method has the disadvantage of expense, and frequently of deterioration of the cable, we may consider the case of a cable hung from the walls or timbers.

In this case if the cable does break the ends are quickly parted, the spark may continue for the fraction of a second, but it has been shown by the experiments of Messrs. Wullner and Lehmann at Aix-la-Chapelle, which experiments were accepted as conclusive by the Prussian Firedamp Commission, "that even violent sparks from rupture of the current, accompanied with the explosion of fragments of iron in a state of combustion, had no effect on the inflammation of firedamp."—(*Colliery Guardian*, Feb. 20th, 1891.)

Considerable light has, in the author's opinion, been thrown on this question by the facts recently stated by Professor Vivian B. Lewis. It appears that the ignition of firedamp arises in most cases, not from the raising of the temperature to the ignition point of firedamp, which is very high, but by the raising of it to the point of its decomposition with evolution of hydrogen, which, becoming ignited, eventually ignites the firedamp. This requires two things: (1) Time (and Professor V. Lewis states that 10 seconds is in some cases necessary); (2) The maintaining of a particular mass of gas in contact with the point where the heat is developed long enough to effect the operation quoted. Neither at the commutator of a motor, nor at the point of rupture of a cable are these conditions fulfilled. In the face of the facts and experiments and experience now at disposal, those who raise the objection to electricity in mining on the ground of safety ought, in the author's opinion, to bring some proofs of that danger if it is to receive consideration. Notwithstanding the extended use of electricity, these causes of accidents do not occur, and, in the opinion of many well qualified to give it, the danger arising from electricity is less than that arising from safety lamps, and enormously less than that arising from almost any explosive agent now in daily use.

Having dealt with this question, it remains to be asked, is the present position of power distribution by electricity such that we may use it with confidence for the whole of the power required at a colliery? The author's answer to this is, yes. In support of this may be given the following facts.

The largest engine at a colliery is the winding engine, and suppose this to require to be capable of developing power at full speed of 1,000 h.p., which is an outside figure, this could be well replaced by two motors of 500 h.p., one on each end of the shaft of the drum, without gearing. There are numerous cases of dynamos and motors of this power working with ease and satisfaction and giving no difficulty whatever, and operated by ordinary mechanics with no more trouble than an ordinary steam engine. Motors of smaller sizes are in use all over the world, with universal satisfaction as to ease of manipulation and low cost of maintenance.

Are the claims made for efficiency of electric distribution of power realized? On this point the author has examined carefully tests made by himself and by others on electric power plants, and has arrived at this conclusion: whilst the efficiency of distributing electric power and its utilization in the motors does come up to that claimed, the efficiency of the production of electricity is not as a rule as high as is claimed or as high as may be realized, and the reason is this: sufficient account is not taken of the fact that the average load is considerably less than the maximum requirements, and the curve given (Plate 22), which is taken from an actual test of a direct coupled engine and dynamo, will show how this operates. Whilst the efficiency of electric generation, that is, the proportion between the electric power delivered to the cables and the indicated horse-power of the engine, is as high as 86 per cent. at full load, it falls to 74 per cent. at half load and to about 58 per cent. at one-quarter load. The reason for this is to be found in the power the engine takes to drive itself. The engine is generally arranged to work with an economical cut-off at the full load of maximum power, and consequently is larger than necessary for all smaller loads. It should be arranged to work with an economical cut-off at the average power, then at a larger power; although the consumption of steam per i. h. p. would be somewhat greater, the mechanical efficiency would be so much better at the average load, that considerable economy, and, indeed, the best possible result would be obtained. The moral is to use engines with automatic expansion valves, permitting the engine to work with a cut-off as late as ½ or ⅝ of the total cylinder volume when developing the maximum power, and working with a more economical grade of expansion at the average load.

To apply the principles advocated in this paper, the method to be adopted should be as follows: When a colliery is opened an estimate must be made of the power which will ultimately be required for the whole colliery. It need not be all provided for at once, but the arrangements must be such that what is provided will be worked at an economical load, and that by simple duplication it may be increased.

An example is given below which may be considered to represent an average case where there is no very heavy pumping:—

TABLE OF POWER REQUIRED AT A COLLIERY.

	Maximum Power. H.P.	Average Power. H.P.	Minimum Power. H.P.
Winding	700	225	0
Fan engine	60	60	60
Pumps	50	50	50
Haulage	200	100	0
Lighting	20	10	10
Screens	20	20	20
Shops at surface	20	5	5
Capstans for waggon handling	20	10	10
Total	1,090	480	155

The power required by the winding and haulage engines are what would probably be required in a colliery drawing about 1,500 tons per day, and the maximum power required by the winding engine is reckoned on the assumption that the weight of the ropes is unbalanced, and the average on the assumption that the winding takes 40 seconds and the unloading and loading 25 seconds. Variations will correspondingly affect these points, and must be made to suit each case.

These powers set down are those required at the separate machines, and if we take it that the loss in the cables at full load is 5 per cent., which will be ample, as the bulk of the power is not far from the source, and that at the average load and upwards the indicated power is as shown on the curve (steam dynamo efficiency, plate 22), that is, $\frac{100}{86}$ of the power delivered to the cables, we get the following as the indicated power required at each load, which, assuming that the electric motor will transform only as much electric power into mechanical power as a steam engine would convert of indicated power into mechanical power, gives a direct comparison between the actual indicated power required if all the engines were worked direct from the boiler, or by the distribution thus to be effected:—

INDICATED H. P. OF GENERATING ENGINES.

Maximum.	Average.	Minimum.
$\frac{100}{86} \times \frac{100}{95} \times 1,090$	$\frac{100}{86} \times \frac{100}{97.5} \times 480$	$\frac{100}{64} \times \frac{100}{95} \times 155$
1,330	572	265

Now it will be observed that the average power is 572 i.h.p., as compared with 480 i.h.p. actually required at the engines. But taking the former Mr. Foster Brown's figure of 6 lbs., and for the latter 1½ lbs., the economy resulting is found from the fraction:—

$$\frac{6}{1.5 \times \frac{572}{480}} \text{ or } \frac{6}{1.78} \text{ or } \frac{100}{29.6}$$

Not far differing from the possible economy spoken of early in the paper.

That such figures are realizable in practice is shown by the figures givenin apaper read before the North of England Institute of Mining Engineers by Mr. Alexander Siemens, and published in vol. 8, part 2, of the Transactions of the Federated Institution of Mining Engineers.

Tests are there recorded where, with a plant considerably smaller than that here considered, a consumption of 2.62 lbs. per e. h. p. hour, equivalent to 2.25 lbs. per i. h. p. hour, were obtained; and in the discussion on the same paper reference was made by Mr. D. B. Morison to a plant using 2 lbs. coal per e. h. p. hour, equivalent to 1.72 per i. h. p.

The writer is aware that in thus advocating the generation of the whole of the power in one engine or pair of engines he is advising a very radical departure from existing and well-tried methods; but the advantage in economy is so great that in his view a revision of method must take place, and in any case the subject is well worthy of consideration and discussion.

Metal Mining.

Fxtracts from a presidential address delivered by Mr. J. H. COLLINS, before the Institution of Mining and Metallurgy, London.

Local demands for special products and by-products.—Such demands may often determine the mode of treatment of an ore. Thus, where there is a local demand for sulphate of copper, or where dilute acids are cheap, a wet process of extraction may be more advantageous than a dry one, or than mechanical concentration; and in such cases it may even be preferable to turn a finished product like copper bars into the less simple form of sulphate. Whether sulphuric acid shall be made or not; whether attempts shall be made to condense arsenic, sulphur, lead, or zinc fume; whether sulphate of iron shall run to waste—the answer to these and a hundred similar problems must depend upon local conditions more than anything else. Basic ores and concentrates may sometimes be sold for prices far in excess of their metallic contents, and in such cases it will often be best to sell in a somewhat crude state rather than to concentrate and refine to a high pitch. Ignorant attempts have been made to smelt tin ores direct to metal in a blast furnace without previous "dressing," but the results, as might have been supposed, were altogether unsatisfactory, unless alloys of tin and iron being produced, much tin at the same time passing into the slag. In many places there may be a demand for slag for cement making, building purposes, railway ballasting, road making, and similar purposes, and the good mine manager will not fail to take such requirements into consideration.

The kind of labor available must be considered by the mining engineer. In old mining countries skilled labor is usually abundant, while the reverse is generally the case in new countries. Anyone who has had to sink a shaft in heavy ground, or to "spill" through running ground with "green hands," will understand the importance of skilled labor in mining, will duly value the services of such born miners as the Cornishman and the Mexican, and will sympathize with the man who finally decides upon driving a long tunnel, or even opening up a great quarry, so as to avoid the initial difficulty, even though it may entail greater difficulties upon those who come after—probably at a time when the new camp has become an old one and skilled labor is no longer rare. Similar considerations will often lead the thoughtful and well-instructed engineer to prefer a crude process of ore treatment to one which, though far more perfect and effectual in skilled hands, would be for him, and under existing circumstances, undesirable, if not altogether out of the question. It was the comparative rarity of skilled furnace-men in the United States which led to the extended use of water-jacketed furnaces; for these, though somewhat expensive at first cost, and rather wasteful in fuel, are easily handled by comparatively unskilled men, and very economical and easy to repair.

Considerations of Climate.—As a general rule, it is no doubt recognized that processes requiring much water are not suited for dry climates, unless there is some abundant natural supply available. On the other hand, some dry processes are at a great disadvantage when operated in very moist climates. One of the best illustrations of climate influences is observable in connection with tin dressing. As there must be a series of operations, and the ores must be mechanically concentrated to a high degree of purity before smelting, this requires cheap and fairly skilled labor, and plenty of water, so that a moist and mild climate is a great advantage. It is not generally known that a really dry state of the atmosphere renders the dressing of fine tin ore a most difficult operation, for, if once the particles get really dry, there is always a heavy loss of float tin.

Possible Scale of Operations.—It is obvious that the administration expenses and other standing charges, and even some of the working expenses, will be much lessened in proportion as the scale of operations is enlarged. But small-scale operations are often the only ones possible, and if the manager is an all-round man the disadvantage may not be so very great after all.

Pilfering and Robbery.—Pilfering is naturally more common in the case of rich than of poor ores and products, and in some cases it exists to such an extent as to seriously affect the financial results of an enterprise. Thus it is that an extensive mine of low grade ores has often an advantage over one of less extent, where the natural concentrations have been more complete. Ores are generally more easily pilfered than ingots; in fact, these latter, when of considerable size, are extremely difficult to steal, and often difficult to realize when stolen.

Transit Facilities.—In general terms it may be said that the transit cost (and insurance) of the precious metals is insignificant as compared with their value; that of ingots of "base bullion" is more noticeable, but still of little importance; that of ordinary ingots of metal or sacks of matter more considerable; that of ores so considerable as often to be prohibitive. As regards supplies, such as timber, fuel and iron, these are often prime necessities, and required in large quantities; while considerable weights of salt, bricks and other commodities are also frequently required. Obviously the advantage of good roads, railways, shipping ports, and other modern transit facilities will be in direct proportion to such requirements of supplies from external sources, other things being equal; while, for want of such facilities, many essentially good mineral deposits are, and must for the present remain, unworked. But although good transit facilities are an advantage as a general rule, there are some important exceptions, more articularly in connection with the precious metals. Thus, a mining region which can itself furnish the necessaries of life and the principal mine supplies, such as fuel and timber, and which only sends away a product of great value in proportion to its bulk, may be much better without a railway. Horse and mule labor is often very cheap and effective in such places, while wages are always low when the food of the laborer is cheap.

Financial Considerations.—The amount of working capital actually available is the real crux of most mining adventures in their initial stages. Both mine and mill are often crippled for want of money, and the manager has to do as he can, and not as he would, so that makeshifts, costly in the end, are frequently unavoidable. But even where money is not actually unobtainable it may happen that a high rate of interest will lead to a modification in the character of the plant at first proposed. In countries where 12 per cent. or more is the normal rate of interest, it will often pay better to employ more unskilled labor; on the other hand, if money can be borrowed at three or four per cent., more and better machinery can be provided with advantage.

Electrical Haulage at Earnock Colliery.

By ROBERT ROBERTSON, B. Sc., M. Inst. C. E.

Some time ago an electric plant was installed at Earnock colliery for the haulage of coal hutches in parts of the mine near to the working faces. where horses had hitherto been used for that purpose. The colliery is situated in a coal field extending to about 1,000 acres, near Hamilton, in Lanarkshire, Scotland, and has been in operation for about 15 years. Five seams are being worked, and in all the haulage has hitherto been accomplished by steam hauling engines, horses and self-acting inclines. From the results of working during about 18 months since the installation was completed, the following is a close approximation to the saving which has been effected. Taking the present output by the two electrical hauling engines at 600 tons in 10 hours it is estimated that, even if the same work could have been done by horses, it would have required 40 horses and 40 men (in addition to those at present bringing the coal from the working faces), to do the same amount of work. The horses of the class employed cost about £30 per head. Renewal and depreciation at the rate of 15 per cent. per annum gives an annual charge of £180. The cost of feeding, etc., is about £30 per annnm per horse. The wages paid to the horse drivers is about 5s. 6d. per day. The annual cost of working with 40 horses is therefore :—

Depreciation and renewal of 40 horses, 15 per cent. of £1,200	£180
Keep of horses, 40, £30 per annum	1,200
Wages of 40 men at 5s. 6d. per day for say 250 days	2,750
Total	£4,130

The annual cost of working and maintaining the electrical installation is :—

One electrical engineer at 10s. per day for 250 days	£125
Twelve men at 6s. per day for 250 days	900
Coals, oil, stores, etc	500
Upkeep and depreciation :—	
Building, say, 5 per cent	30
Machinery, pulleys, ropes, etc., 15 per cent on £2,900	435
	£1,990

Deducting the cost of working and upkeep of the electric haulage plant from the estimated cost of doing similar work by horses, shows the substantial saving of £2,140 per annum to be effected by the electrical installation.

The steam is obtained from existing boilers at the colliery, and no appreciable difference has been observed in the consumption of coal since the new machinery was started; but in making such a comparison as the above, the probable cost for coal should be assumed as if the steam were supplied from a separate boiler. From experiments to test the efficiency of the plant, the following information was obtained: The loss in the engines is about 16 horse-power; in the shafting about 0.45 horse-power; in belt and dynamo friction, 3.4 horse power; and in exciting the dynamo, 2.2 horse-power. These losses, approximately constant for all loads, amount to about 22 horse power, and constitute the engine room losses. The loss in the engine is large on account of the available steam pressure being low—only 50 pounds per square inch.—*Proceedings Institute Civil Engineers.*

Shipment of Canadian Phosphate.—A shipment of 300 tons of phosphate was made this month from the High Rock mine, near Buckingham, Que.

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Canada and the Gold Boom.

We all want to be rich, and nature's way of getting rich is for men to work. But hard work is not pleasant, and the whole world is in quest of an easy way of getting rich, a royal road to wealth. Multitudes of men who are not physically adapted to manual labor, or who are constitutionally averse to bodily effort seek to make a living by their wits; by getting possession of something and disposing of it to another for more than it cost. They persuade a person to part with goods at the lowest price he can possibly be induced to accept and their efforts are then devoted to ascertaining what is the highest price that others can be prevailed upon to give. In some cases, instead of buying from individuals they persuade the government to give them great privileges, franchises, charters, grants of land, protection against competitors by special customs duties, and they proceed to make the most of these gifts and favors by extorting the utmost value in return for their disposal or use. Instead of buying property outright, some engage in betting whether prices will rise or fall. They may select any kind of merchandise for which there is a general demand, or they may place their wagers upon shares in chartered companies, and employ brokers to place their bets in the stock exchange. All this is called doing business. Some persons bet upon cards, horse races, elections or other chances of life This is called gambling. There seem to be three classes engaged in making a living: workers, business men and gamblers, though other classes manage to exist—idlers, beggars and thieves. The idlers are the heirs of rich people or else retired capitalists; beggars are those who live on charity, and the thieves are those who take the property of others without consent. These six classes constitute society.

The only class that can be commended from an ethical standpoint is that of the workers, including those who labor with their brains to perform a useful service. But, strange to say, this class is looked down upon by fashionable society and it is only business men, or idlers who live upon past business gains, who are considered respectable. This social endorsement, combined with the greater ease of business life, leads to an avoidance of physical labor by all who have the intellect and opportunity to gain wealth through securing an advance in values. One charm of this method is its frequent rapidity. A fortune may be made in a year, a month, a day, or an hour, if the tide of speculation is taken at the flood; whereas, to gain a competency by labor, involves a lifetime of weary toil, under most disheartening contingencies. No wonder then that multitudes seek the easy, popular, fashionable road to wealth, although they know that many fall by the way and that of the final goal of affluence, it may be said: "Few there be that find it."

The latest exhibition of this effort to grow rich by betting has been given by the investors in gold mining shares in London. This is spoken of as the mining craze, the gold mania; but it is nothing of the sort. People hear that certain shares are rising in value, and they buy, hoping that the rise will continue. Their opinion is not based upon any judgment of merits, but upon the probability of popular favor. The question is not, is it good? but, will it go? These people are not always fools, they are not usually misled by any false or exaggerated statement as to the value of the property. Their only interest is in the fact that the shares are higher today than they were yesterday, and that there is a good chance that they will be higher tomorrow. Hardly any one buys the shares as an investment hoping for a dividend. They simply seek to sell the shares at an advanced price and get out before the reactionary crash comes; and most of them know that it is bound to come.

Many of the companies formed to operate South African mines have been able to get their shares made a means for speculation even before they commenced operations, and to find their value increased many fold, although there was not the slightest prospect of a dividend in the near future. One company, called the East Rand Proprietary Mines, Ltd., is mentioned in the *Investor's Review* as not having enjoyed a sixpence of revenue, and yet having the market value of its shares raised by speculation from $650,000 to £7,000,000.

The *Investor's Review* for November contains an interesting and well-written article entitled "Notes by the Way on the Mining Market Gamble." It describes how the excitement spreads by rumors:—

"Every day in the city, and all day long, the ear catches scraps of the market chitterings like these:—'Jack Bounder is retiring; made a pot of money; hadn't two sixpences to rub together a year ago.' 'To my certain knowledge, Ted Swagger was absolutely gravelled in '93; had to borrow a 'fiver' from Bill Fulloblud to get a new suit of clothes; now the cad drives a phaeton and pair, splendid cobs too; 'tis said he has made £300,000.' 'Guess who I met yesterday?' 'Cant.' 'Why, Tom Sparrowbrain.' 'You don't mean that; what's he doing?' 'Made his pile, he says; bought a nice place down in Berks, keeps a spiffin' turn-out, and spends £5,000 a year at least.' 'Well, I'm blanked; why, he hadn't two shirts when I saw him last.'

Of such are the stray talks of the street, and the words come forth with a touch of admiring envy in them quite beautiful to behold. The speakers seem to be awe-struck as much almost as envious. But it is when the tittle-tattle falls on the South African millionaires that the voice deepens into a tone of reverential worship. 'So-and-so has made five, six, millions, sir, in two years; and has got the money too,' the devotees cry. You feel a kind of creepy sensation in the back as words like these are thrown at you, so profound is the veneration expressed by the utterer. . . . . . The average British dunderhead might not comprehend the 'cyanide process,' 'adits,' 'deep levels,' and 'dwts. to the ton,' but he felt he could comprehend a duke: and when the Duke of Abercorn and the Duke of Fife, with a whole troop of the labelled and unlabelled at their heels, attached themselves to the fortunes of the 'Chartered Company,' he became awake to the fact that there must be something in it.' From this conviction to 'buying blind' was but a day's sleep. All must be right when the ''usband of the Prince of Wales' daughter tho't it good enough for 'im,' as grocer Jones and tailor Spratt would remark to each other over their pipes and beer. After this endorsement of rank and fashion, cupidity felt itself ennobled and sanctified. Generals of the army and admirals of the fleet were at equal liberty with the poorest scrag of humanity who served them, to descant at dinner-tables, with the diner-out's know-everythingness, upon the remarkable gold deposits of South Africa."

But it is not only the investors in rising shares who make profits; a horde of promoters, underwriters, advertising agents and publishers reap fortunes. A man comes to London with a mine or a "prospect." He finds a promoter, styled "Financial Agent," to take up the matter. The promoter finds a man who agrees to advance the money for advertising, provided he is repaid three times his outlay in case the company floats. He buys an influential board of directors by gifts of blocks of shares. He finds underwriters, who, for a commission of from 10 to 25 per cent. guarantee the subscription by the public of a certain amount of shares. Advertising agents, who have valuable lists of investors names, address 100,000 or 1,000,000 prospectuses and receive handsome pay. Newspapers are paid large sums for notices and editorials. Blackmail is levied by obscure "Financial Journals," who threaten attack if not subsidized. To meet all these expenses the price to be paid for the mine is increased five or ten fold and the surplus is divided by the promoter between himself and these various claimants. Anyone will see that the chance of a mine becoming a dividend payer is seriously handicapped by this inflation of its value and all the expense entailed by the organization of a company to be managed by numbers of salaried persons. To pay a dividend even on the par value of the shares a mine must be enormously rich, but when the shares are advanced tenfold the prospect of returns is poor indeed. The literary feature of promotion is well described in the *Review* as follows :

"In estimating the chances, one must never forget that an inexpressibly degraded type of financial press here and in France, has potently aided the great market 'bosses,' 'trusts,' 'banks,' blind pools, underwriting syndicates, and other nondescrpit combinations in sharpening the appetite of a greedy public, and still aids it. In both countriés it is 'so much puff for so much money,' but the French are, on the whole, more economical in their press expenditure than we are, and work the oracle with less unctuous affectation of 'honesty.' Banks and financiers over there openly buy up journals, or the financial pages of journals, and fill them with artistically compiled, or other advertisements of their wares, paid for at the usual wage. In London, it is, with a few glaring exceptions, a locust-swarm of wageless, or low-waged, individual writers who have to be bought ; and the prices these gentlemen, or the owners of certain journals, charge for the use of their pens, or brains, rise with the success of the 'boom.' Our great South African adventurers found most of the financial press lean and hungry, thankful to insert a 'leader' for a ten-pound note, or to publish quotations of manufactured 'share premiums' for half the money. It is quite otherwise now, as the engineers of the 'Western Australian gold mining boom' have found to their cost ; as the leaner sort of promoter sadly admits. A fifty-pound note does not go so far to-day in buying eulogies of new schemes—dressed up in a margarined affectation of impartiality and honest conviction—as a 'fiver' would have done a year ago, and, in consequence, mine-company hatching has become nearly impossible except to very strong cliques. It is not, either, as if the promoter had to do with only a few papers ; he now faces a hoast, all clamorous for hush-money or blackmail. The development of the market excitement has brought into life a swarm of ephemeral prints, which may have little or no money value as agencies for puffing rotten schemes, but whose power for harm might be appreciable were they allowed to speak the truth, or to say all the bad things unsatisfied lusts could dictate. It is necessary, therefore, to keep the poorest rags in tow by paying them extravagant sums to insert advertisements of prospectuses, or for laudatory leaders and 'pars' sometimes written with considerable art, often the merest soap-suddy drivel—in praise of the 'Stonebrooke' mine or the 'Deep Sea' prospecting company, whatever the 'vendors' have to palm off upon the ravenous swarms of brainless gamblers, who hate labor but love 'style' and comprehend good feeding and dukes."

The *Whitehall Review*, chiefly subscribed to by officers and officials, both active and pensioned, warns its patrons as follows :

"The Blackmailer is, for the moment, king. At least a dozen rags, purporting to be financial journals, fatten on the company promoter. If the latter, who is generally of shady antecedents, does not give a £20 or £30 advertisement, the organ of light and leading so flouted comes out the next day with a sensational article, and a still more sensational poster, something in this way :—

THE GREAT BONUM MINE, LIMITED.

AN IMPUDENT PROSPECTUS—SOME STARTLING FACTS ABOUT THE PROMOTERS.

If, on the contrary, the financial blackmail journalist gets his check, he will insert an unblushing and generally ungrammatical puff of the Great Bonum Mine, and his leading article and poster will deal with the iniquities of some other company, the promoters of which have not paid their price. . . . The insertion of the prospectus of any venture in these rags is a pretty convincing test that the promoters of that company are afraid of exposure. Of course the prospectus of some other than swindling companies appear occasionally in these organs of blackmail. In that case be assured that the venal advertising agent has included such a paper in his list in order to grasp at a higher discount than is allowed by a respectful journal. A good many of the bogus financial papers which now flood the city are bringing in fabulous sums to their proprietors. If justice were meted out, most of these gentry would be in the dock on charges of obtaining money by threats."

The chance for dividends commensurate with the prices to which South African shares have advanced in the London market is forcibly put as follows by the *Investor's Review* :—

"If the annual gold-production of South Africa rose to £30,000,000 gross,—it is not yet £10,000,000,—and if two-fifths of this, or £12,000,000, were net profits fairly distributable among the shareholders in the 'mining companies,' 'chartered companies,' 'banks,' 'trusts,' and 'finance companies,' whose shares still soar at aerial heights, the money would barely pay 6 per cent. on the recent market prices. But there is no reasonable prospect that the output of gold in South Africa will ever reach £20,000,000 gross, let alone £30,000,000, and still less that two-fifths of the total product can ever be fair net profit ; and there is no ground whatever to suppose that the maximum output, whatever it may be, will be sustained for ten years. A solitary mine here and there may endure for that time, or longer, and pay—most will do nothing of the kind. If the average return to the "investor" is 1 per cent. all over on the market price of the shares, it will be a marvel."

It is of course incredible that the present value of shares can be maintained and it might be supposed that the gold mining industry will suffer by the reaction in prices. But it will be the speculators, left with shares on their hands, who will be the mourners, and for a time it will be difficult to start new enteprises. But the mines that have a good basis of value will operate as well as ever and that there are many such is proved by the returns. Bradstreet's gives the following summary of the history of South Africa Gold Mining :—

"Nearly 30 years ago gold was found to exist in the South African Republic, or, as it is often called, the Transvaal. What are known as the mines of the Lydenburg district, in the eastern part of the Transvaal, were worked as early as 1869. They continued to be moderate producers, yielding an average of about $1,500,000 gold per annum, until they were overshadowed by the Witwatersrand. The latter is a district surrounding the town of Johannesburg, about 35 miles south of Pretoria, the capital of the republic, and on the watershed between the Limpopo and Vaal rivers. It is in the midst of a rolling country, about 5,600 feet above sea level, and, up to the time of the present development, was regarded as useless for anything but grazing. Gold was believed to exist in the region 20 years ago, but it was not till 1884 that any systematic attempt was made to work it. At first the miners and prospectors sought only for rich pockets, which are occasionally found along the outcrop of the reefs, and only after a couple of years was it realized that in the conglomorate rock which accompanied such deposits was the true source of the country's mineral wealth. Several years of exploration, of partial failures and uphill work, ensued, but nevertheless the productiveness of the fields was evident, while they attracted not only a swarm of experienced American and Australian miners but gave employment to increasing amounts of British capital, and presented examples of the highest practical development of science applied to gold mining and extraction. From 1887, when, by the use of primitive methods and appliances, 'the Rand' produced some 23,000 ounces of gold, up to last year, when its output reached a total value of $35,000,000, there has been a growing interest in it which has culminated in the most remarkable speculative excitement of modern times. While attention has been given to West Australia gold discoveries, as well as to the working of the reefs of Mashonaland and Metabeleland (the latter having been partially worked in ancient days by some unknown race) the measure of success that has attended the operations of the miners and prospectors of the Rand has been the chief support to the whole speculative mining movement."

An especial reason why this South African excitement should interest Canadians is the fact that just now large areas in British Columbia are giving evidence of the presence of valuable deposits of gold. In the existing rivers and creeks and in the beds and banks of ancient rivers alluvial gold is found, which by placer or hydraulic mining yields a rich return to the worker. Dredges and pumps are bringing the nuggets up from deep water, and the monitors are washing the gold dust out of the soil. All along the southern borders of the province large bodies of iron and copper bearing rocks are found carrying gold either in good quantities or in sufficient amount to pay if worked economically on a large scale. There are also large districts containing free-milling gold quartz, and a great region with silver-lead mines, which, owing to their high grade and extent, are considered by many to be of surer value than any of the gold mines. The hydraulic and placer gold mines of the Caribou, Fraser, Thompson, Columbia, Tulameen, Similkameen and Kettle Rivers, the gold ore mines of Trail Creek, Boundary Creek and Okanagan, and the silver mines of Slocan in West Kootenay are destined to gain a world-wide fame. Nowhere is capital and the absence of repressive legislation more needed. With free scope for the application of money, unhindered by restrictions against the building of railroads and the importation of supplies, there will come a development of mineral resources that will astonish the world. But the successful opening up of these riches depends upon the way in which the work is undertaken. If companies are floated on the London plan, at large capitalization and with immense expenses attending their organization and subsequent management, and the selection of the properties they shall work is left to the interested promotors, ghastly failures will soon occur that will dishearten investors and discourage operations. If on the other hand judicious and practical men will take up carefully chosen ground that has not got inflated by boomers. paying moderate prices to the original discoverers and proceeding to work upon business principles, there will undoubtedly be a record of successes that will establish the permanency of profitable mining in British Columbia.

Undoubtedly there will follow a boom, wild company promotion and gambling in shares. But there will exist a solid basis of productive wealth that will ensure a continued operation of mines even if speculators are crushed in the ruins of a declining market.

It is reported that several large companies are already formed in London, with a view to developing British Columbia properties. There is not so much to be hoped from these hap-hazard enterprises as from the intelligent and systematic operations of practical Canadian and American miners, who will work up the mines from small beginnings and avoid the fiascos that are apt to follow operations directed by a board of foreign directors, chiefly remarkable for their titles or their success in gulling the public. It is to be hoped that the preliminary work of opening up the country will be done in a business-like manner, and that our capitalists will be willing to invest their means in efforts to develop legitimate mining operations, rather than risk them by gambling in the shares of companies that have only fictitious or problematical workings as a basis for existence. A few successes will bring practical mining men of world-wide reputation to invest their means and devote their energies to the efficient working of the ore bodies. Already the declaring of dividends by the War Eagle mine at Trail Creek, B.C., has brought in the great mining men of the west to buy up neighboring properties; and the interest is extending westward so that we hear of the advent into the Boundary Creek district of such famous names as Marcus Daly, John A. Finch, Farrell and Midgeon, and other mining kings of America.

Premier Turner of British Columbia when in England lately said: "What is wanted in order to attract more attention to the province is some actual returns in the form of dividends from some of our large new mines. When this is forthcoming, which will, I believe, be very soon, we shall have a proportionate boom in the precious metals of British Columbia to that which is taking place with regard to South Africa. At the present time South Africa is, to a certain extent, attracting a great deal of capital which we should like to draw to British Columbia I have been talking to several parties interested in South African mines, and on my suggesting that probably a great deal might be lost, as there is so much gambling in mining stocks, and that it would be better for them to transfer their investments to British Columbia, the invariable reply is:— 'Large fortunes have been and are being made in South Africa, not only by members of the stock exchange, but large dividends have actually been paid to the shareholders at home.' When capitalists see the published returns of these companies they naturally think that South Africa is the best place for them to invest in. What we want in order to divert attention to British Columbia is to have a good output from our mines and to have it made known, and thus to show that British Columbia mines can pay dividends, thereby giving an opportunity of our figures being compared with other mineral producing countries."

The effort of those interested in Canadian mining progress should be to encourage the working of promising mineral prospects and to discourage all legislation that increases the cost of mining or prevents the building of lines for transportation. Great districts are waiting for the advent of railways. The ore is of too low a grade to bear the cost of wagon hauling, packing by horses and raw-hiding. But with the coming of the railroad, we shall see the smelter, the concentrator, the cyanide and chlorination works, and perhaps even the electric smelter, taking hold of the hitherto neglected rocks, and by the new, cheap and effective processes they will pour out wealth that will place Canada in the front rank of the mining countries of the world.

It is not only in British Columbia that the mining boom will strike. From the Atlantic to the Pacific mineral wealth abounds throughout Canada. The coal of Nova Scotia, the Northwest and the Pacific coast; the gold of Nova Scotia, Chaudiere in Quebec, Hastings County, Rainy Lake and Rat Portage in Ontario; the nickel of Sudbury; the iron of Ontario; and many silver mines scattered along the great lakes—all these invite the attention of the investor who would seek wealth from the rocks.

Our plea is for work in intelligently conducted mines, rather than for gambling in the shares of companies solely promoted, not to mine in the earth but to burrow into the pockets of those who have the greed for gain without the ennobling sentiment of producing wealth.

Advice may be given in consideration of the foregoing remarks to two classes of people: First, to the owners of mining prospects or partially developed mines. Do not go to London to sell your properties at a large figure to grand companies. The large price is usually on paper and the vendor is fortunate if he gets away with the coat on his back. The chance of successful working of the mine by a company organized with a large capital and managed expensively by absentees is very small. It is the fashion to decry the efforts of Americans in Canada and to appeal to the patriotic sentiment of "British capital for the British empire." But a true spirit of loyalty would welcome the speedy development of the country and would welcome a foreign capitalist or an American railway, if by their means mines could be worked that would otherwise be idle for years. Considering that the capital invested in initial enterprises is very apt to be lost, there should not be any reluctance to letting strangers take the risk.

The following advice, written to a Canadian mine owner by one of the most eminent mining experts in the United States is pertinent here:—"I think that it will be far better to have the property taken up by a live American syndicate or company, than by one of those English development companies to which you refer. The latter would take forty years getting to work, while the American company will be working the property for all it is worth before the English company could get through wrangling about formalities and holding long-winded meetings of directors, who know about as much of what they are discussing as a monkey knows of the man in the moon."

If the owners of mining property would consent to take a large proportion of its price in shares of the company, thus sharing in the risk and profits of the work, a vastly greater number of operations would be undertaken and much larger sums would sometimes be realized by the vendor. Capitalists will put up money to work but they are loth to pay it out in advance for the privilege of working.

Secondly, the lesson to capitalists who wish to do legitimate mining is never to invest in an over-capitalized and grandly officered company. If they wish to gamble in shares the company with the greatest amount of buncombe may be the best, but if they seek dividends from mining operations let them get near to bed-rock and know the men who are in charge.

But men will gamble rather than work and wait, and in spite of all preaching the boom will come. Colorado will produce as much gold as South Africa, and British Columbia has perhaps an even greater capacity. The boomsters have their eye on these quarters, and if public interest is aroused by large returns of profit, speculation in shares and the organization of wild-cat companies is sure to follow. In spite of the disasters that eventually come from these efforts, a certain amount of good results to the country from the expenditure of money, and what is one man's loss is another man's gain. At any rate it is well to understand the true meaning of these movements, and such articles as that in the *Investor's Review* are valuable and timely.

Gold Mining in Nova Scotia.

Through the courtesy of Mr. W. H. Brown, Accountant of the Mines Department, Halifax, we are able to furnish our readers this month with a complete return of the quartz crushed and the yield of gold therefrom as reported to the Department from 1st January of the present year to 30th September last. As some of our readers last year claimed that their returns, although reported for the year, only represented a certain number of months actual work, we have in this statement taken pains to show the months for which returns have been officially reported. In order to prevent misconception it is well to remember that our figures must not be confounded with those given in the Mines Report, which cover the fiscal year ended 30th September. Our returns, which are for the nine months of the present year, are as follows :—

Name of District.	Name of Mill or Co.	Months in which Crushing was done and Returns Made.	Quartz Crushed.	Yield of Gold.			Total Yield.		
			No. of Tons.	ozs.,	dwts.	grs.	ozs.,	dwts.,	grs.
Sherbrooke	McNaughton Co	Jan., Feb., March, June, July, Aug., Sept.	665	458	10	0			
	Stellarton Gold Co	Jan., Feb., March, April, May, June, August	1,904	903	9	0			
	New Glasgow Gold Co	September (only)	150	101	0	0			
			2,719	1,462	19	0	1,462	19	0
Oldham	Concord Mill	January (only)	5	4	12	4			
	Oldham Gold Co's Mill	Jan., Feb., March, April, May, June, July, August	324½	168	13	0			
	H. Whidden	Gold mortared during the month of June	....	1	13	15			
	J. Dowell	" " " "	....	4	4	15			
	J. E. Vandegrift	" " " June, July, August	....	18	11	7			
			329½	197	14	17	197	14	17
Waverly	Tudor Gold Mining Co	Jan., Feb., March, April, May, June, July, Aug., Sept	4,457 14/20	989	7	0	989	7	0
Moose River and Caribou	Moose River Gold Mining Co	Jan., Feb., March, April, May, June, July, Aug., Sept	1,645¾	443	10	0			
	Damas Touquoy's Mill	Jan., Feb., March, April, May, June, July, Aug., Sept	3,599	298	9	12			
	W. A. Sanders	Jan., April, May, June, July, Aug., Sept	3,146½	376	13	0			
	Gardner Clish's "	Jan., Feb., March, April, May, June, July, Aug., Sept	314	281	4	0			
	A. M. Jack's "	April, May, June, July, August	522	110	10	15			
	H. Dixon's "	Jan., Feb., March, April, May, June, July, Aug., Sept	734	901	10	0			
			9,961¼	2,411	17	3	2,411	17	3
Uniacke	J. J. Withrow "	Jan., March, April, May, June, July, Aug., Sept	381	428	18	6			
	Golden Lode "	Feb., March, April, May, June, Aug., Sept	151	1,309	9	8			
	T. R. Prince's "	Jan., Feb., March, April, May, June, July, Aug., Sept	1,670	191	11	0			
(Phœnix.)	John Madill's "	May, June, July	496	12	15	15			
	Eastville .... "	Jan., Feb., July, August	105	64	2	22			
	D. McDonald's. "	May, July, August	25½	15	5	18			
			2,828½	2,022	2	21	2,022	2	21
Lake Catcha	John H. Anderson's "	Jan., Feb., March, April, May, June, July, Aug., Sept	640½	467	9	0			
	Oxford... "	Jan., Feb., April, May, June	310¼	88	1	0			
			950¾	555	10	0	555	10	0
Stormont	Richardson Gold Min. Co's Mill	Jan., Feb., March, April, May, June, July, Aug., Sept	7,806	1,248	0	0			
	Eureka Co's "	Feb., March, April	137½	68	14	12			
	John McMillan's "	February	56	18	16	0			
	Antigonish Mg. Co's "	January, February	705	237	3	0			
	Jas. A. Macdonald's "	June, July, August, September	70¼	68	12	0			
(Modstock Co.)	J. D. Copeland's "	June, July, August, September	1,042	764	0	0			
	Country Har. Gold Mg. Co's "	January, February, March, April, May	1,279	374	5	0			
			11,095¾	2,779	10	12	2,779	10	12
Brookfield, (Queen's)	W. L. Libbey's "	Jan., Feb., March, April, May, June, July, Aug., Sept	2,869	1,699	2	10			
	Philadelphia "	May, June	100	19	18	0			
			2,969	1,719	0	10	1,719	0	10
Beaver Dam	Beaver Dam Co's "	Jan., May, June, July, (August from plates)	432	46	4	21	46	4	21
Montague	Nova Scotia Gold Mines "	Jan., Feb., March, April, May, June	673½	276	10	0	276	10	0
Malaga	Malaga Mining Co. "	August, September	90	44	2	0	44	2	0
Kemptville	Kempt Mg. Co's "	April, June, July, Aug., Sept	149	101	15	15	101	15	15
15 mile stream	New Egerton Co's "	Jan., Feb., March, April, May, June, July, Aug., Sept	3,522	1,967	14	0	1,967	14	0
Renfrew	Pictou Dev. & Mining Co's "	Jan., Feb., March, April, May, June, July, August	847	956	12	0	956	12	0
Wine Harbor	New El Dorado "	January, February, March	265	112	4	11	112	4	11
Tangier (proper)	Essex "	May	40	11	14	0	11	14	0
Mooseland—Tangier	Mooseland Gold Mg. Co's "	May, June, July, Aug.	1,690	92	5	5	92	5	5
Gold River	T. N. Baker's "	June, July, August, September (No quartz filled in for Aug. and Sept.)	37 June and July	120	3	0	120	3	0
Liscomb Lake	John Power's "	August and September	27	11	8	10	11	8	10
							13,099	4	17

Since we received these figures we are advised of additional returns from A. M. Jack's Mill at Caribou for September as follows :— 35 tons quartz, yielding 40 ounces of gold, making the output from this mill for the six months, 150 ozs., 10 dwts., 15 grs.

The Iron Industry in Nova Scotia.

This industry, in common with the coal trade, has experienced the dullness which has prevailed over the American continent. It is pleasing to note that it has recovered and is at present prosperous.

During the twelve months under review the New Glasgow Iron, Coal and Railway Company has been united with the Nova Scotia Steel Company, the enterprise which Nova Scotians can justly point to as probably the most successful joint stock enterprise ever launched in the province. This company is extending its operations and is supplied with an admirable Bessemer pig from its furnace at Ferrona The possibility of lengthening the runs of this furnace on steel material is in itself an item of economy, rendered feasible by the growth of the steel works. The furnace was started again in the summer and ready sales of pig are since reported. After a long vacation the Londonderry works went into blast again, and it is reported are contemplating the reopening of their rolling-mill. The large contract secured by this company for the pipes of the new gas company in Halifax will keep their foundry running for some time. The charcoal furnace at Bridgeville, Pictou county, had a short campaign of about a month. As yet, however, the price of charcoal pig has not recovered itself sufficiently to permit of their continuous operation. It may be questioned if the admirable pig made here would be available for steel making, as is the case with some of the better Swedish brands.

The Torbrook mine has been running steadily with a total output of 29,940 tons divided between Londonderry and Ferrona. The vein worked at this mine improves in depth, in quality and thickness, and has been found to extend about three-quarters of a mile to the westward of the present works.

The Nova Scotia Steel Company have suspended operations at their Arisaig mines, having discovered a deposit of iron ore of higher grade at Bell Island, near St. John's, Nfld., which they are opening for shipment next spring.

The production of pig iron stands as follows for the twelve months ended Sept. 30th, 1895, although the output is more truly for the last six months of that period :—

	Tons.
Pictou Charcoal Iron Co.	323
Nova Scotia Steel Co.	17,321
Londonderry Iron Co.	11,446
Total	29,090

Returns so far received show that during the year there were 79,636 tons of ore mined, of which amount the Charcoal Company, in addition to 598 tons smelted, mined and sold 7,541 tons. There were 36,532 tons of coke reported from the Pictou coal mines and the Ferrona furnace, and about 25,050 tons of limestone quarried.

It is anticipated that the Londonderry and Ferrona furnaces will make a large and steady output for some time ; so that next year's operations, which have already made a promising start, will make the best returns yet shown.

Little has been done with any of the other well-known iron deposits of the province. The furnaces are well supplied with ore, and freight considerations prevent much competition for local furnace supplies. Should the scheme of building a blast furnace at St. John be carried out, there is no doubt that the iron ores of the Bay of Fundy will be largely drawn upon, and should the prices of iron in the United States continue to rise, a demand will be made for high grade and conveniently situated ores in Nova Scotia. In this connection may be mentioned the accessible and purer deposits of Torbrook and Nictaux, and the ores lying between Maitland and Windsor.

Coal Mining in Pictou and Cumherland Counties, N.S.

The returns so far as can be gathered at date of writing do not show the coal trade of Cumberland and Pictou as specially flourishing during the twelve months ended September 30th, 1895. The output of the Springhill mines was necessarily interrupted by the destructive bank head fire, and in Pictou county the prevailing dullness of trade, and the keen competition of Cape Breton coal at common points, contributed to keep the production down.

The total sales of Cumberland coal for the year were about 422,210 tons compared with 479,350 tons in 1894, a falling off of 57,140 tons. In Pictou county the sales were about 367,205 tons, as compared with 412,039 tons during the preceding year, a deficiency of 44,834 tons ; the total shrinkage in sales for the two counties being about 100,000 tons.

The Londonderry furnaces were idle from Oct. 1st, 1894, to March 9, 1895, and the Ferrona furnace was also out of blast for some time. This lessened the sale of slack for coke and other iron making purposes from both counties. It is anticipated that the demand for coke will be steady during the winter and that the Cumberland collieries will have to work full time to complete railway stocks and to supply local consumers.

At the Joggins mines operations have been interrupted several times, but attention has been paid to the important matter of having plenty of coal where it can be promptly extracted when needed. At the River Herbert mine Mr. Hall has deepened his slope 200 feet, and expects to work steadily during the winter. At the other small mines, as usual, a few hundred tons are sold during the cold weather. At Springhill the coal has been drawn through the No. 1 or East slope, and a large amount of the coal left years ago in the pillars has been successfully robbed. The bank head at the north slope has been rebuilt and is again in working order. With these two openings the company will be in a position to meet all demands made on it.

In Pictou county work was continued as usual at the Intercolonial Coal Co's mines. A coal washer was put in and other improvements, with a view to reducing working expenses. The Acadia Co. has rebuilt the bank head lost about a year ago, at their Westville mine, and this veteran slope is still turning out a regular supply of its well known fuel. At the Third and McGregor collieries at the Albion mines operations are being continued in the usual quiet style. Operations commenced at some expense in the main seam to the westward of the Foster pit were stopped, as the coal did not prove good enough to work. In the Foord pit workings the fan shaft was made air-tight, and arrangements made for building off a connection with the older workings so that air being excluded the water in these workings could be lowered sufficiently to permit of the workings in the third seam being extended for about 500 feet to the dip. At the Vale colliery work continued dull all the season. The seam has thinned considerably, and proves expensive to work.

American Metallurgy.

The series of lectures entitled "Recent American Methods and Appliances Employed in the Metallurgy of Copper, Lead, Gold and Silver," delivered by Mr. James Douglas before the Society of Arts, and which have been published in the recent issues of the Society's Journal, are full of interest and contain a mass of very useful statistics of costs. Mr. Douglas fully appreciates a fact which is too often overlooked in comparing American methods with English and German methods. He says, "What is true of mechanical appliances is equally so of certain metallurgical processes admittedly American, some of which —while valuable, because peculiarly adapted to local or even special climatic conditions—are not so accurate and economical as to receive the stamp of general acceptance. There are, in fact, two standards by which metallurgical as well as other technical processes and practices are to be judged—the standard of absolute excellence and that of economical utility. The series of operations by which the minutest trace of each valuable constituent of an ore is recovered, represents no doubt the highest standard of the art of metallurgy; but on the other hand the process by which the most money can be made out of an ore in a given locality is generally awarded in practice the reward of adoption, even though it be wasteful and reprehensible from a scientific and technical point of view. Remembering that most of the larger mineral deposits of the United States are situated far from the centres of population and of chemical industry, where, therefore, by-products are of little or no value, where fuel and re-agents are dear, and where labor, owing to its scarcity and the great cost of living, commands higher wages than in any other section of the Union, it can readily be conceived that the simplest, not the most complicated, even though it be the most perfect; the speediest, not the most thorough process will be selected, with a view to saving only the most important constituents of the ore, regardless of its subsidiary and less valuable elements. Men who risk their money, and those who forfeit their comfort to recover what Nature has hidden in the wilderness are liable to overlook small savings in their hunt for wealth, and to be guilty of committing the crime of permitting heavy metallurgical waste so long as it does not involve pecuniary loss."

In dealing with copper concentrating at Lake Superior Mr. Douglas gives the costs of mining and concentrating at the Atlantic mine which are certainly worth reproducing. The ore is broken in a rock-breaker, crushed in steam stamps and concentrated by jigging in Collom jigs and the slimes by round buddles. From 200 to 300 tons of ore are crushed daily.

The following was the output and working cost last year:—

Rock stamped ....(tons)	315,626
Product of mineral..................(pounds)	5,687,665
Product of refined copper.........(pounds)	4,437,609
Yield of rock (per ton).........14 pounds—	0.703%
Total cost of mining, selecting, &c...	$0.7518
Transport to mill.	0.0303
Stamping and separating	0.2330
Total cost of mining and concentrating.....	1.0151
Freight, smelting and marketing...........	0.1771
Total cost of mining, treating and marketing the product, per ton..................	1.1923
Gross value of product.....	1.3376
Profit per ton	$0.14

Turning from the concentration of copper ores to that of galena, the methods and cost of working at the St. Joe mine are given, here the ore is crushed dry and screened through trommels with six more holes, then wetted and concentrated, and sized in 92 two-compartment jigs. Prof. Munroe, of Columbia College, attributes the success of thus jigging coarse and fine, including slimes, to the coarseness of the bed. He says: "The plan of jigging sands and slimes together, makes it possible to treat very much finer material with success, than has heretofore been supposed possible. The limit of successful work on jigs is generally placed at 1 mm. The successful jigging of stuff ⅛ mm. and less marks a decided advance in the art of dressing. The coarse grains form the intestrial channels in which this very fine stuff can be concentrated. It is well known that any attempt to treat stuff finer than 1 mm. by itself, results in very imperfect working of the jigs, the losses being large and the capacity of the jig small. The advantage of this system of jigging is the large proportions of sands successfully treated and finally disposed of by the roughing jigs alone. Out of 800 tons per day, only 136 required further treatment, viz: 30 tons raggings crushed and treated on the 3-sieve jigs, 66 tons of fine sand, also treated on the 3-sieve jigs, and 40 tons of slimes treated on the side bump tables."

The cost of concentrating is 36.4 cents per ton, being 13·1 cents higher than at the Atlantic mine.

The author next deals briefly with gold hydraulicing and the milling of free gold and silver ores. He strongly condemns the policy of the owners of the Comstock, where he considers that metallurgical economy has been subordinate to the exigencies of speculative owners and stock manipulators, who have required an enormous output, even though it involved heavy operating losses.

In dealing with calcining furnaces Mr. Douglas confines himself to three types, namely, rake furnaces, shaft furnaces with long drop, and cylinder furnaces. The most popular rake furnaces are modifications of the O'Hara. The Brown-Allan, O'Haras as used at Butte, are constructed with two hearths 100 feet long and 9 feet wide, with four fire-places, two on each side of the upper hearth They roast from 45 tons to 50 tons of concentrates per day, reducing the sulphur to 6 per cent. In some furnaces the lower hearths are produced beyond the limits of the furnace to serve as a cooling floor. When employed for roasting preparatory to smelting, the floor of the lower hearth may terminate in a hopper, whence the accumulated hot ore drops into reverberatories.

Mr. R. Pearce, of Argo, has designed a turret furnace, from which very good results have been obtained. In this furnace the machinery imparts a revolving motion to radial arms and ploughs; the arms are hollow tubes through which air can be forced on the surface of the ore at a certain stage in the roast, thus cooling the arms and ploughs and accelerating oxidation. The fireplaces supply extraneous heat. These furnaces may be built with several hearths above each other, thus prolonging the roasting where complete oxidation is required. Mr. Pearce says, "The turret roasting furnaces have been in constant operation at these works (Argo) for a period of about three years. I have had ample opportunities of testing their capacity on ores and mattes of different kinds. The following results have been obtained from runs of sufficient quantity of material to ensure their correctness, and they are certainly very conservative. To test the capacity of the furnace for roasting, I made use of Gilpin County tailings containing 79·5% of pyrite, representing 42·1% of sulphur. Of this material the furnace was able to roast 9·8 tons per 24 hours down to 0.22% of sulphur at a cost of $1.15 per ton."

"Pyrite containing little or no foreign elements carrying 46% of sulphur, has been roasted to 4·46% of sulphur, at the rate of 14·76 tons per day and at a cost of 71 cents per ton."

"An ordinary mixture of ores, containing pyrite with from 20 to 30% of silica may be roasted to 4.75% of sulphur at the rate of 16 tons per day and at a cost of 70 cents."

"Matte containing lead to the extent of from 10 to 15% and 30 to 35% of copper, has been roasted to 6% per cent of sulphur at the rate of 13 tons per day and at a cost of $1.00."

The following table is well worth reproducing as it gives the cost and efficiency of four kinds of rake calcining furnaces in use in America:

			Improved.	
	Reverberatory.	Old Spence.	Segmental.	Rectangular.
Cost of construction at Butte	$4,500 00	$2,500 00	$8,500 00	$10,000 00
Yearly running time......	360 days.	320 days	340 days	360 days
Daily gross capacity......	10 tons.	7 tons	30 tons	43 tons
Labor for 24 hours furnace and tramming.......	$ 9 33	$4 38	$11 50	$9 95
Fuel	10 00	None	1 00	2 50
Repairs and shut downs...	1 00	$3 00	2 50	1 25
Power......	None	2 50	1 00	1 00
Sinkiug fund (6 per cent.).	$0 79	0 42	1 42	1 67
Total Expenses.........	$21 12	$11 30	$17 42	$16 37
Cost per ton...........	2 00	1 91	0 58	0 41

In dealing with revolving furnaces Mr. Douglas instances the Bruckner with intermittent feed and discharge and the White-Howell with continuous feed and discharge. Both types do good work. The former is used more as an oxidizer, while the latter is useful as a chloridizer. The White-Howell gives an output of nearly 40 tons per day, and the Bruckner 20 tons, while an ordinary reverberatory rarely exceeds 10 tons. The Stetefeldt (which is a shaft furnace in which the ore drops down a slightly coned shaft 48 feet high and meets a heated oxidizing or chloridizing atmosphere) has a capacity of from 70 to 100 tons per day.

For the chloridizing roasting of silver ores the author favors the Stetefeldt above all other types.

Following this comes an interesting article on the chlorination of gold and silver ores. A good account is given of the Russell process, which consists of leaching with a double sulphite of soda and copper ($2Na_2\ S_2\ O_3$, $3\ Ca_2\ S_2\ O_3\ 5H_2O$.) This double sulphite is not only more active in dissolving silver chloride, but it violently attacks native silver, as well as the sulphide and double sulphides of silver with arsenic and antimony.

By far the ablest part of these lectures is that portion devoted to copper smelting.

Mr. Douglas deals briefly with the methods adopted by the Anaconda Co., the Orford works, the New Jersey Extraction Co., the Nicholls Copper plant, the Pennsylvania Salt works, the Parrot Company of Butte, Messrs. Lewisohn and others, in the east. At the Orford works large brick matting furnaces are used, and the regulus is brought up to blister in the reverberatory. The argentiferous and auriferous copper is cast into anodes which are electrolyzed at the Balbach works in Newark. In addition to this they make a brand of cast copper which ranks with the best selected of the English smelters. The refining capacity is about 3,000,000 lbs. of copper monthly.

Thanks to the introduction of the low water-jacketed cupola furnaces the western people are now capable of smelting copper at the mines, and the eastern smelters are no longer able to rely on the west for their supplies, so have to import foreign ores. In the west the ores are almost entirely smelted in Piltz furnaces (a water-jacketed cupola). The copper is tapped directly from the crucible through a tap-hole generally 18 inches below the tuyers. The slags are often rich in copper. Mr. Douglas says, "It inevitably follows that the slag drawn from a hearth through which particles of 96% copper are falling must be rich. The operation was wasteful, but none other under the conditions was profitable. The large furnaces of the Detroit Copper Co. have a small fore-hearth, the water-jacketed shell of the furnace serving as a tymp. This allows the copper a better opportunity of settling, but the advantage is slight." Mr. Douglas continues by giving a lengthy account of the construction of the furnace followed by copper smelting in Montana, the bessemerizing of copper mattes and pyritic smelting in Colorado, which lack of space prevents our going into. He also gives an excellent account of several wet processes, such as the Mounier, Whipley & Stover, Hunt & Douglas, Ziervogel-Pearce, Crook, and the manufacture of copper sulphate.

Turning to the metallurgy of lead: In the Missouri, Mississippi and South Kansas districts, which produce 20% of the lead smelted in the United States, no less than 62.47% is smelted in a modified Scotch hearth, so altered as to entitle them to the distinction of being American furnaces operated in a distinctly novel manner.

Mr. Douglas gives the following description of the furnace:—"The simpler hearths of this district differ from the old pattern only in that the walls of the well and tuyer-back are water-jacketed. Thus the operation is not interrupted at short intervals to permit the hearth to cool. But a much more radical departure from the simple hearth has been made by E. R. Moffet, of the Pitcher Lead Co's works, formerly of Lone Glen Co's works at Joplin. The Moffet hearths are built back to back and discharge into a common stack. The lead-well of iron is suspended between four pillars and cooled by exposure to air; while in a hollow back, which forms the partition between adjacent hearths, the blast is heated. This hearth, with the same amount of labor, treats more than twice as much ore as hearths operated by the cold blast. But the percentage of lead recovered as metal is only half as great. This, however, is an advantage, as the fumes, after being cooled by passing through coils of iron pipe, are forced and collected into bags of the Lewis & Bartlett white lead apparatus. These discolored fumes, with the rich grey hearth slag and some crude galena, are extracted in a slag furnace constructed with double tiers of tuyeres in which as much lead as possible is volatalized. The fumes issuing from the cupola, after parting with their heavier particles in a brick chamber and flue, are burnt so as to oxidize suspended carbon dust and to convert lead sulphide into lead sulphate before being cooled and forced by a fan into a series of woollen bags. The composition of the Bartlett blue power and white lead is given by Hoffman as follows:—

	Roasted Blue Powder.	Refined White Lead.
Insoluble.	——	0.08
$Pb\ SO_4$	48.76	65.00
Pb O	46.82	25.89
Zn O	0.27	6.02
$Fe_2\ O_3$	0.32	0.03
Ca O	0.48	0.02
$C\ O_2$	0.90	2.00
$S\ O_2$	1.65	——
$N_2\ O$	0.37	0.85
$Al_2\ O_3$	0.05	——
$Si\ O_2$	0.10	——

The slags from the furnace are said by Holibaugh to be practically clean; and as all the lead fumes from both the hearth and the slag-furnace are caught and converted into a saleable product, one of the main objections to the Scotch hearth (its wastefulness) is removed"

In Leadville, Denver and Pueblo, mechanical furnaces of various types are used to roast and matte the ore, but hand furnaces are much more widely retained in lead than copper works.

"The smelting furnaces are large cupolas, originally designed on the Raschette model, then verging towards the Piltz, and finally reverting to the Raschette type. . . . A usual size is now 40 x 120 inches. All are built with a bosh and all are jacketed within the zone of fusion. Most are provided with the Avento syphon tap, a discharge built into the crucible wall and communicating with the bottom of the lead well. In all the superstruction is supported on pillars to facilitate the removal of defective sections. In most establishments coke and charcoal mixed is the fuel, but in one instance, at least, uncoked lignite, mixed with coke made from the same is used very successfully."

Desilverizing the lead is done by the Parks process. The size of the kettle has been increased from 12½ tons capacity to 30, and in a few instances 45 to 50 tons. The kettle is discharged by the Steitz syphon. Base bullion running 300 oz. silver and gold is desilverised by two zinkings, if no separate gold crust is made; otherwise by three. The methods of liquating the crust has been improved and retorting the argentiferous zinc has become an established method of work.

EN PASSANT.

We take pleasure in announcing to our readers the appointment of Mr. F. H. Mason, F.C.S, Halifax, as Associate Editor Mr. Mason, in future, will have charge of our Nova Scotia correspondence.

The ordinary general meeting of the Mining Society of Nova Scotia which was to have taken place at Halifax on 21st instant, has been postponed until Thursday, 4th December, when we trust there will be a large attendance. Among the papers to be presented we notice "The Capacity of Coal Cutting Machinery," by Mr. W. Blakemore, M.E., Assistant Manager, Dominion Coal Co., Ltd.; "A Mineralized Zone in Nova Scotia, by Mr. H. S. Poole, M.A., A.R S.M., Manager Acadia Coal Co., Ltd.; and "A Cable Hoist as applied to Low Grade Ore," by Mr. C. E. Willis, M.E.

Nearly twenty papers have been promised for the next meeting of the General Mining Association of the Province of Quebec to be held in Montreal during the second week in January. As in former years the meeting will last for three days.

A feature of this meeting will be the Student's Session, when papers will be submitted in competition "for medals and other rewards," a grant of fifty dollars having been made for this purpose. This competition is open to any Canadian student for original papers on subjects connected with mining, mineralogy, chemistry and such other matters as may come within the scope of the profession of mining engineering. A number of entries are promised from McGill, and it is hoped the Mining School at Kingston, and other technical schools will also be represented.

Mr. J. Burley Smith, M.E., of Glen Almond, who has for a number of years been manager for the British Phosphate Company in this country, sends us the following wire from Nipegon, Ont., received too late for insertion in our last number: "Kindly announce in current REVIEW that I have discovered an outcrop of the celebrated Sultana gold quartz lode on two islands slightly southwest of Sultana mine and have acquired both. Mining operations will promptly commence. Sultana gold brick, last week's working, 10-stamps, $2,450."

Mr. W. Penn Hussey, managing director of the Broad Cove Coal Co., Ltd., Cape Breton, was in Ottawa during the month arranging with the Government for the dredging of the proposed shipping harbor at Broad Cove.

Mr. John Blue, C. & M.E., of the Eustis Mining Co., Capelton, President of the General Mining Association of the Province of Quebec, passed through Ottawa on 20th instant on a visit to the Lawn silver mine, Calumet Island, Que.

The shipments of Canadian phosphate during the season will aggregate about 1,000 tons. The Phosphate of Lime Co., through Wilson & Green, made one cargo of 271 tons, 80%, to Liverpool, and Mr. J. S. Higginson, Buckingham, 250 tons 80%, to the same port. The other shipments supplied Canadian and United States consumers. The last reports of the European market are very bad, 80% being quoted at 6½d. per unit delivered at Liverpool and no rise over 80°/₀. Florida is being pressed for sale at 6⅛d. for 75–80°/₀, delivered in the Mersey. The United States markets have also been very depressed, Tennessee phosphate completely shutting us out of both Chicago and Buffalo, where this product is being offered at $7.00 for 65–70°/₀, delivered grouud. Freight to Chicago at $3.25 and grinding charges $2.25 leaves very little to be made by phosphates at this price.

Mr. W A. Carlyle, Mining Engineer, Montreal, has, after some hesitation, accepted the position of Government mineralogist, offered to him by Col. Baker, Minister of Mines for the Province of British Columbia. Mr. Carlyle graduated from McGill University in 1887, having gained the British Association gold medal for proficiency in engineering subjects, and also first class honors from Sir William Dawson in natural sciences, viz., geology, mineralogy, chemistry and petrography. After two seasons' work on the staff of the Geological Survey, he became mining engineer for Mr. D. R. C. Brown, Aspen, Colorado, one of the largest and most successful mining operators in that State, and while there he was constantly engaged in the various operations of mine engineering, mine examinations, surveying and lawsuit work in the largest mines in that famous camp. At Aspen Mr. Carlyle put in the dams, flumes, ditches, pipe lines, etc., of a water supply sufficient to generate 2,000 h. p. of electric power, Aspen being the first place on the continent to introduce successfully the general use of electricity in all mining work. He was also connected with the construction of a large mill for the concentration of low grade ores, and spent a considerable time in making a complete survey and geological examination of Smuggler Cut in Colorado for Mr. Brunton, a prominent English engineer, who specially sent to Canada for Mr. Carlyle to take charge of the work. In relation to this service Mr. Brunton says: "Mr. Carlyle has made for me maps, geological sections and models of many mines in this district and in other parts as well as in Montana. For the past two years he has been engineer for me upon the Cowenhoven M T. & T. D. Tunnel Company and the property of the 'Della S. Mining Company,' all the works of which he has completely mapped, sectionised and modelled. All the work has been performed in a most satisfactory, manner, and it is with deep regret that I learn of his intention to return to Canada. Mr. Carlyle has thoroughly familiarized himself with the different methods of mining, valuing mines and treating precious metal ores, and in short has lost no opportunity of studying the details of his profession, and I can heartily recommend him for any position connected therewith." Mr. Carlyle was afterwards appointed professor and lecturer at McGill University on mining and metallurgy, which appointment he now holds, and he was specially recommended by Dr. Dawson and the President of the University as peculiarly fitted for the appointment of Provincial Mineralogist for British Columbia. His duties will consist of visiting and inspecting the mining districts of the Province and reporting to the Minister of Mines on the same, and his official reports will be available for the information of the public. In 1892 Mr. Carlyle visited professionally the iron and copper mines of Lake Superior; in 1893 he worked in the gold mills of Central City and afterwards in the smelters at Denver; in 1894 he visited some mines in New York and other States, and also in eastern Canada, and the late summer vacation he has spent professionally in the Black Hill country in the United States.

In Mr. Carlyle the Government of British Columbia has secured a sound, conscientious engineer of considerable ability, whose services will be of the greatest value in the new department to which he has been appointed.

The discovery of large and valuable deposits of chromic iron ore is reported to have been made lately on the west side of Port-au-Port Bay, Newfoundland. The dispatch says: "The length of the seams (?) is 240 ft. on the surface and there are eight veins (?) varying in width from 5 to 12 ft. of solid 'piece' ore, of which 7 cubic feet weighs a ton. An excavation of 8 ft. has been made, indicating a widening of the seams (?). The mine is just a mile from the water, and the ore will be conveyed half way by trolley, and then by an endless cable, lowering it into the ships without a wharf being necessary at all. When spring opens 400 men are to be put to work."

An interesting example of the electrical transmission of power is being carried out by Messrs. Johnson and Phillips, of London and Charlton, at the Sheba gold mines, ten miles distant from Barberton, South Africa. This installation is described in an illustrated pamphlet issued by the firm. Hitherto the ore has been conveyed to the stamps, a distance of three miles, by means of an aerial tramway, but the development of the mines has been so great that the directors of the Sheba Gold Mining Company decided early last year to lay down additional stamps, not on the site of the then existing stamps, but at the mine itself, and to transmit the power for working them by means of electricity. The electrical energy is transmitted through five miles of underground cable, curving round the hills from the Queen's River. The available water power is estimated at about 600 horse power, and two 300-horse power turbines have been laid down for driving the generators. The power-house, which has been built on a slope by the Queen's River, contains two alternators, and the current is transmitted to the receiving-house at the mine. Here the pressure is reduced by means of transformers, and electrical energy is conveyed by other cables to different points for the operation of motors working the stamps, pumps, settlers, breakers, etc.

Prof. W. A. CARLYLE, B.A.Sc., M.E.

Government Mineralogist to the Province of British Columbia.

MICA MEN IN SESSION.

Standard Grades and Uniformity in Prices Discussed.

Under the auspices of the General Mining Association of the Province of Quebec a meeting of Canadian Mica Producers was held in the Russell House, Ottawa, on Thursday afternoon, 14th instant. Captain Robert C. Adams, Montreal, Vice-President, in the chair. There was a large attendance; among others present being noticed: Mr. T. G. Coursolles, (Wallingford Mica Co.) Ottawa; Mr. Lewis K. McLaurin, (McLaurin Mine) Templeton; Mr. Davidson, (Vavasour Mining Association) H. Bumgarten, (Canadian Mica Co.) Ottawa; Lt.-Col. Wright, (Cascades Mica Co.) Ottawa; W. Wallingford, (Wallingford Mica Co.) Templeton; S. P. Franchot, (Villeneuve Mica Co.) Buckingham; W. F. Powell, (Clemow & Powell) Ottawa; J. Burley Smith, M.E., Glen Almond, Que.; E. B. Haycock, Ottawa; C. A. Chubbick, Ottawa; F. Cirkel, M.E. Ottawa; Don. C. Watters, (Lake Girard Mica System) Ottawa; F. Clemow, (Clemow & Powell) Ottawa; E. D. Ingall, Chief of the Mining Bureau Geol. Survey of Canada, Ottawa; W. Sears, Ottawa, and B. T. A. Bell, Editor CANADIAN MINING REVIEW.

CAPTAIN ADAMS, in opening the proceedings, said he was glad to meet so many gentlemen who were active workers in mica. He had had something to do with the mineral in the past, and having tender memories of past experience, he expressed his pleasure at meeting gentlemen who were successful. He would ask Mr. Bell, "the power behind the throne," to explain to them exactly the object of the meeting. As he understood it it was to consider in what way the mica business could be advanced by coming to some understanding with regard to prices. When he sold 200 tons for 75 cents a ton it was before mica was used for electrical purposes, and we have all seen it grow from that time until now the price amounts into the hundreds of dollars, and it would seem desirable that there should be a conference of those interested in the matter to come to some understanding—to see what it really is worth, what its market value is, so that a price might be established which would tend to prevent a slaughter of the material and enable all to get a just price without attempting to engage in extortion.

MR. B. T. A. BELL stated that Captain Adams had explained the objects of the meeting correctly. It had been called at the request of a large number of miners, amongst whom some dissatisfaction was prevalent respecting the existing methods of selling the product, both as regards prices and grades. With regard to prices it would be difficult to regulate them without the co-operation of every producer. Something would be accomplished by organization. A uniform standard of grading was eminently desirable and this, it seemed to him, could be easily determined by a conference of those interested in the production of the mineral.

MR. T. G. COURSOLLES.—If there is a way of coming to an understanding about prices so as not to undercut each other it would be a good thing, but the question of different kinds of mica comes up here. There is good mica and indifferent mica. Therefore, all mica cannot be sold at the same price even if we wanted to. If we were to establish an invariable rule for every kind of mica, then those who have mica of a poor quality might not be able to sell it at all, especially if the dealers and consumers were in the habit of getting first-class mica. Still there might be some way of coming to an arrangement about that. Men who produce large quantities may sell by the ton or carload, while others who do not produce so much have to sell by the few hundred pounds, and the man who contracts for 50 tons or 100 tons in a year can afford to sell it a little cheaper than the man with a few tons, because the only way the latter can get a return for his labor is to sell it trimmed or rough but graded, so that it might be found very difficult to determine upon a strict price list. We have sold hundreds of tons in the last three years, but latterly we have reduced our output on purpose because we found that we could make more money by reducing the output and selling in other ways. If you sell by wholesale necessarily the price must be lower than you sell by retail. If we sell to dealers who do not produce mica themselves we have to give them a reduction on the price. We have to protect the interests of the dealer, and there seems to be a price for the consumer and a price for the dealer.

MR. B. T. A. BELL said he could mention several instances where quantities of mica had been sold at suicidal prices, which did not begin to pay the cost of production.

MR. COURSOLLES.—Small miners or owners of lots who have found a few tons of mica will go to Montreal or elsewhere and sell it for whatever they can get, but they never sell much there, perhaps only a few tons.

MR. S. P. FRANCHOT.—As a dealer in mica he would say that that was the trouble. One never could tell what they were buying there were so many different grades. When I go to sell mica in the States I say to every party, "I will sell you 2x4 trimmed." Well, the next question is, "What do you mean by that?" Then again another mica man will offer 2x3, and 3x5, at a different price. There seems to be no proper method of grading. Now I hear that one man will sell 2x3 and 4x6 inclusive for $225 a ton, rough split, and that another will offer 1x3, and 4x6 for the same price. They are not worth the same price. The only way over the difficulty would be to sell 2x4 mica for so much money and 4x6 for so much money, and not guarantee anything larger than 4x6. I give those figures simply for illustration—you might make it 2x3 or 3x5. It has been stated to me in the States that they never would pay more than 60 cents for mica of any size, because if they had to pay more than that they would build up from small mica. Another will say that he does not use mica any more; that he uses brown paper.

MR. COURSOLLE.—It costs at least a dollar—they cannot do it for 60 cents.

MR. SEARS thought that a certain standard of grades should be decided upon. He thought the consumer of mica certainly knew what he bought—2x3 or 4x6. The Westinghouse Company in former days used brown paper and pasted scraps of mica on it, but they use nothing now but solid mica. They will not likely use brown paper again, and if they want big mica they should pay the price. The consumers are limited and they must have mica. They have not found anything to take the place of it yet and until they do they should pay the price for the big size.

CAPT. ADAMS.—Is micanite as effective as an insulator as the crude mica?

MR. COURSOLLES.—No; it is made up with shellac. It does very well for places where it does not come in contact with the electrical fluid. Lately we have had quite a demand for large mica and we sold some at from $1 to $1.50 a pound—in small orders, that is, 50 to 500 pounds.

CAPT. ADAMS enquired if the demand for small mica was found to be increasing.

MR. COURSOLLES said it has always been good and is increasing.

CAPT. ADAMS remarked that one of the difficulties seemed to be with the farmer and other small operators in selling at any price. A farmer has a little plot of ground out of which he takes half a ton. It is comparatively large for him and he is willing even to get half the market price, and it would seem to be a difficulty which the genuine mica miners have to confront—to prevent the price being established by those outside operators, men who only sell a little. He suggested that it might be well for the mica producers to sell through one channel. The basis would have to be a central company with capital enough to buy from each miner, then each man would have an interest in the thing.

MR. D. C. WATTERS thought that in order to establish a standard the best plan would be to determine the value of material as put through the Customs and build from that. No one seems quite sure what the discounts are and there is also discrepancy between the rough and trimmed material.

MR. FRANCHOT said that they should establish a price list and let the buyer in the States pay the duty. The price for duty is the price in Ottawa or Montreal, therefore it would behoove the producer to establish a price list in Canada.

MR. DAVIDSON suggested that the mica be divided into three grades—1x3 to 2x4, and 2x4 to 3x5 and 4x6.

MR. COURSOLLES stated that his company shipped without stating any grade but only sell 1x3 to 4x6 inclusive, or 2x3 to 4x6 inclusive, for which they asked a different price.

MR. POWELL said that if a grade be established and everyone sell at the same price the man who has the nicest mica is going to sell every time and the man with the dark mica or hard mica has to stand on the outside until they have disposed of their stock.

MR. BAUMGARTEN did not think that a standard price amongst mica men would hold for the simple reason that when there is a scarcity of money they will sacrifice their stuff and undercut each other. The only practical way was to have a sort of a pool and let each man contribute to the treasury, with which they could buy the mica, paying so much down and then afterwards dividing up *pro rata* the difference which the mica was sold for to the people in the States. If an association could be formed where men would put a little money into it, he would be willing to contribute so that a sort of combine might be formed to protect prices. He did not mean to stick people. The man hard by is not going to wait until he sees what his opponent is going to get. The small people are the first ones to ship mica at any price and that is the difficulty at present in matters of duty. His father informed him that the reason why the U. S. Customs enforce the highest price is because there is no standard price.

MR. DAVIDSON said the first thing was to establish a price in Canada in order to meet the Customs regulations in the States.

MR. WATTERS asked how they were going to determine upon the grade. If they fix the grade 1x3 and 2x4, and then 2x3 and 3x5, suppose a consumer wanted a grade of mica 2x3 and 2x4, would he have to pay the price of the nearest standard grade to what he wanted?

COL. WRIGHT believed that there was a necessity for a mica association. The producers have been cutting their own throats right along. If they had a standard price here there would be no trouble about the customs. Let the American buyers look after their own customs duties.

MR. FRANCHOT suggested that if an association he formed, it be a legally incorporated company with a certain amount of capital, so that if, say Mr. Coursolles has ten tons of mica to sell take it in at the market price, then turn round and sell to the consumer in the States, and at the end of the year when a balance is struck, divide the profits *pro rata* amongst the men who went into the pool.

MR. DAVIDSON.—All mica produced to be sold through the association—no sales made outside of it?

CAPT. Adams said that it seemed to him that the suggestion made to form a committee to consider the manner in which a mica association might be formed was a good one.

MR. BELL suggested that a small organization be formed, embracing every mica miner, without at first having any specific object other than the general interests of the mica trade, and from this they could go on from one thing to another, determining grades, &c. He moved, seconded by Mr. Coursolles, that such an association be formed, and that a preliminary committee be appointed to devise ways and means.

The following committee was then struck:— H. Bumgarten, (Canadian Mica Co., Ltd.); T. G. Coursolles, (Wallingford Mica Co.); B. T. A. Bell, (CANADIAN MINING REVIEW); W. Davidson, (Vavasour Association); D. C. Watters, (Lake Girard Mica System); W. F. Powell, (Clemow & Powell); S. P. Franchot, (Villeneuve Mica Mine; Lewis K. McLaurin, (McLaurin Bros.); and R. L. Blackburn, (Blackburn Mine.)

Moved by Mr. Bell, seconded by Mr. Franchot, that Mr. Davidson be appointed Secretary.—Carried.

A vote of thanks was unanimously passed to the Chairman, and to Mr. St. Jacques for the use of the room, and the meeting adjourned.

MEETING OF THE COMMITTEE.

A meeting of the committee was held at the Russell House on Wednesday, 27th November, when there were present: T. G. Coursolles, (Wallingford Mica Co.); Lewis K. McLaurin, (Blackburn Mine); G. S. Davison, (Vavasour Mining Association); H. Bumgarten, (Canadian Mica Co.); W. F. Powell, (Clemow and Powell.)

Mr. Coursolles was moved to the chair, and after discussion, it was resolved "that the mica miners form a section to be known as the Mica Section of the General Mining Associotion of the Province of Quebec; that the section comprise all the producers and owners of mica property; and that the section be represented by a chairman, a secretary, and an executive committee of five."

It was decided to recommend for consideration at the next meeting of the section that the standard grade of mica rough split and edge trimmed be 1x3 to 2x4, 2x4 to 3x6, 3x6 to 4x7, and 4x7 up. These resolutions will be submitted at a general conference to be held in the Russell House, Ottawa, on 11th December next.

It was also decided to recommend that the selling price of all mica exported shall he based on the value of mica in Canada governed by grades.

The Rarer Metals and their Alloys.*

By Prof. W. Chandler-Roberts Austin, C.B., F.R S.

The study of metals possesses an irresistable chaim for us, quite apart from its vast national importance. How many of us made our first scientific experiment by watching the melting of lead, little thinking that we should hardly have done a bad life's work if the experiment had been our last, provided we had only understood its full significance. How few of us forget that we wistfully observed at an early age the melting in an ordinary fire of some metallic toy of our childhood; and such an experiment has, like the "Flat iron for a farthing," in Mrs. Ewing's charming story, taken a prominent place in literature which claims to be written for children. Hans Anderson's fairy tale, for instance, the "History of a Tin Soldier," has been read by children of all ages and of most nations. The romantic incidents of the soldier's eventful career need not be dwelt upon; but I may remind you that at its end he perished in the flames of an ordinary fire, and all that could subsequently be found of him was a small heart-shaped mass. There is no reason to doubt the perfect accuracy of the story recorded by Anderson, who at least knew the facts, though his statement is made in popular language. No analysis is given of the tin soldier; in a fairy tale it would have been out of place, but the latest stage of his evolution is described, and the record is sufficient to enable us to form the opinion that he was composed of both tin and lead, certain alloys of which metals will burn to ashes like tinder. His uniform was doubtless richly ornamented with gold lace. Some small amount of one of the rarer metals had probably—for on this point the history is silent—found its way into his constitution, and by uniting with the gold, formed the heart-shaped mass which the fire would not melt, as its temperature could not have exceeded 1000°C; for we are told that the golden rose, worn by the *artiste* who shared the soldier's fate, was also found unmelted. The main point is, however, that the presence of one of the rarer metals must have endowed the soldier with his singular endurance, and in the end left an incorruptible record of him.

This incident has been taken as the starting-point of the lecture, because we shall see that the ordinary metals so often owe remarkable qualities to the presence of a rarer metal which fits them for special work.

This early love of metals is implanted in us as part of our "unsquandered heritage of sentiments and ideals which has come down to us from other ages," but future generations of children will know far more than we did; for the attempt will be made to teach them that even psychology is a branch of molecular physics, and they will therefore see far more in the melted toy than a shapeless mass of tin and lead. It is really not an inert thing; for some time after it was newly cast, it was the scene of intense molecular activity. It probably is never molecularly quiescent, and a slight elevation of temperature will excite in it rapid atomic movement anew. The nature of such movement I have indicated on previous occasions when, as now, I have tried to interest you in certain properties of metals and alloys.

This evening I appeal incidentally to higher feelings than interest, by bringing before you certain phases in the life-history of metals which may lead you to a generous appreciation of the many excellent qualities they possess.

Metals have been sadly misunderstood. In the belief that animate beings are more interesting, experimenters have neglected metals, while no form of matter in which life can be recognized is thought to be too humble to receive encouragement. Thus it is that bacteria, with repulsive attributes and criminal instincts, are petted and watched with solicitude, and comprehensive schemes are submitted to the Royal Society for their development, culture, and even for their "education," (1) which may, it is true, ultimately make them useful metallurgical agents, as certain micro-organisms have already proved their ability to produce arseniuretted hydrogen from oxide of arsenic. (2)

It will not be difficult to show that methods which have proved so fruitful in results when applied to the study of living things, are singularly applicable to metals and alloys, which really present close analogies to living organisms. This must be a new view to many and it may be said, "it is well known that uneducated races tend to personify or animate external nature," and it is strange, therefore, to attempt, before a cultured audience, to trace analogies which must appear to be remote, between moving organisms and inert alloys, but "the greater the number of attributes that attach to anything, the more real that thing is." (3) Many of the less known metals are very real to me, and I want them to be so to you; listen to me, then, as speaking for my silent metallic friends, while I try to secure for them your sympathy and esteem.

First, as regards their origin and early history, I fully share Mr. Lockyer's belief as to their origin, and think that a future generation will speak of the evolution of metals as we now do of that of animals, and that observers will naturally turn to the sun as the field in which this evolution can best be studied.

To the alchemists metals were almost sentient; they treated them as if they were living beings, and had an elaborate pharmacopœia of "medicines" which they freely administered to metals in the hope of perfecting their constitutions. If the alchemists constantly drew parallels between living things and metals, it is not because they were ignorant, but because they recognized in metals the possession of attributes which closely resemble those of organisms. "The first alchemists were gnostics, and the old beliefs of Egypt blended with those of Chaldea in the second and third centuries. The old metals of the Egyptians represented men, and this is probably the origin of the *homunculus* of the middle ages, the notion of the creative power of metals and that of life being confounded in the same symbol. (4)

Thus Albertus Magnus traces the influence of congenital defects in the generation of metals and of animals, and Basil Valentine symbolizes the loss of metalline character, which we now know is due to oxidation, to the escape from the metal of an indestructible spirit which flies away and becomes a soul. On the other hand, the "reduction" of metals from their oxides was supposed to give the metals a new existence. A poem (5) of the thirteenth century well embodies this belief in the analogies between men and metals, in the quaint lines:

> "Homs ont l'estre comme metaulx,
> Vie et augment des vegetaulx,
> Instinct et sens comme les bruts,
> Espirit comme ange en attributs."

"Men have being"—constitution—like metals; you see how closely metals and life were connected in the minds of the alchemists, and we inherit their traditions.

*A Lecture delivered on March 15, 1895, before the members of the Royal Institution.

(1) Dr. Percy Frankland specially refers to the "education" of bacilli for adapting them to altered conditions. Roy. Soc. Proc. Vol. LVI., '94, p. 539.

(2) Dr. Brauner, Chem. News, Feb. 15, 1895, p. 79.

(3) Lotze, "Metaphysic," 49, quoted by Illingworth. "Personality, Human and Divine." Bampton Lectures, 1894, p. 43.

(4) Berthelot, Les Origines de l'Alchimie, 1885, p. 60.

(5) Les Remonstrances ou la complainte de nature a l'Alchymiste errant. Attributed to Jehan de Meung, who with Guillaume de Lorris wrote the Roman de la Rose. M. Meon, the editor of the edition of 1814 of this celebrated work, doubts, however, whether the attribution of the Complainte de Nature to Meung is correct.

"Who said these old renowns, dead long ago, could make me forget the living world?" are words which Browning places in the lips of Paracelsus, and we metallurgists are not likely to forget the living world; we borrow its definitions, and apply them to our metals. Thus nobility in metals as in men, means freedom from liability to tarnish, and we know that the rarer metals are like rarer virtues, and have singular power in enduing their more ordinary associates with firmness, elasticity, strength and endurance. On the other hand, some of the less known metals appear to be mere "things" which do not exist for themselves, but only for the sake of other metals to which they can be united. This may, however, only seem to be the case because we, as yet, know so little about them. The question naturally arises, how can the analogies between organic and inorganic bodies now be traced? I agree with my colleague at the Ecole des Mines of Paris, Prof. Urbain Le Verrier, in thinking that it is possible (6) to study the biology, the anatomy, and even the pathology of metals.

The anatomy of metals—that is, their structure and framework—is best examined by the aid of the microscope, but if we wish to study the biology and pathology of metals, the method of autographic pyrometry, which I brought before you in a Friday evening lecture, delivered in 1892, will render admirable service, for, just as in biological and pathological phenomena vital functions and changes of tissue are accompanied by a rise or fall in temperature, so molecular changes in metals are attended with an evolution or absorption of heat. With the aid of the recording pyrometer we now "take the temperature" of a mass of metal or alloy in which molecular disturbance is suspected to lurk, as surely as a doctor does that of a patient in whom febrile symptoms are manifest.

It has, moreover, long been known that we can submit a metal or an alloy in its normal state to severe stress, record its power of endurance, and then, by allowing it to recover from fatigue, enable it to regain some, at least, of its original strength. The human analogies of metals are really very close indeed, for, as is in the case with our own mental efforts, the internal molecular work which is done in metals often strengthens and invigorates them. Certain metals have a double existence, and, according to circumstances, their behavior may be absolutely harmful or entirely beneficial. The dualism we so often recognize in human life becomes allotropism in metals, and they, strangely enough, seem to be restricted, to a single form of existence if they are absolutely free from contamination for probably an absolutely pure metal cannot pass from a normal to an allotropic state. Last, it may be claimed that some metals possess attributes which are closely allied to moral qualities, for, in their relations with other elements, they often display an amount of discrimination and restraint that would do credit to sentient beings.

Close as this resemblance is, I am far from attributing consciousness to metals, as their atomic changes result from the action of external agents, while the conduct of conscious beings is not determined from without, but from within. I have, however, ventured to offer the introduction of this lecture in its present form, because any facts which lead us to reflect on the unity of plan in nature, will aid the recognition of the complexity of atomia motion in metals upon which it is needful to insist.

The foregoing remarks have special significance in relation to the influence exerted by the rarer metals on the ordinary ones. With exception of the action of carbon upon iron, probably nothing is more remarkable than the action of the rare metals on those which are more common; but their peculiar influence often involves, as we shall see, the presence of carbon in the alloy.

Which, then, are the rarer metals, and how may they be isolated? The chemist differs somewhat from the metallurgist as to the application of the word "rare." The chemist thinks of the "rarity" of a compound of a metal; the metallurgist, rather of the difficulty of isolating the metal from the state of combination in which it occurs in nature.

The chemist, in speaking of the reactions of salts of the rarer metals, in view of the wide distribution of limestone and pyrolusite, would hardly think of either calcium or manganese as being among the rarer metals. The metallurgist would consider pure calcium or pure manganese to be very rare. I have only recently seen comparatively pure specimens of the latter.

The metals which, for the purposes of this lecture, may be included among the rarer metals are: (1) those of the platinum group, which occur in nature in the metallic state; and (2) certain metals which in nature are usually found as oxides or in an oxidized form of some kind, and these are chromium, manganese, vanadium, tungsten, titanium, zirconium, uranium, molybdenum (which occurs, however, as sulphide). Incidental reference will be made to nickel and cobalt.

Of the rare metals of the platinum group I propose to say but little; we are indebted for a magnificent display of them in the library to my friends, Messrs. George and Edward Matthey, and to Mr. Sellon, all members of a great firm of metallurgists. You should specially look at the splendid mass of palladium, extracted from native gold of the value of £2,500,000, at the melted and rolled irridium, and at the masses of osmium and rhodium. No other nation in the world could show such specimens as these, and we are justly proud of them.

These metals are so interesting and precious in themselves that I hope you will not think I am taking a sordid view of them by saying that the contents of the case exhibited in the library are certainly not worth less than ten thousand pounds.

As regards the rarer metals which are associated with oxygen, the problem is to remove the oxygen, and this is usually effected either by affording the oxygen an

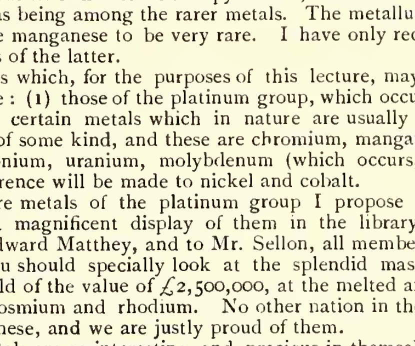

Fig. 1.

opportunity for uniting with another metal, or by reducing the oxide of the rare metal by carbon, aided by the tearing effect of an electric current. In this crucible there is an intimate mixture, in atomic proportions, of oxide of chromium and finest divided metallic aluminium. The thermo-junction (A, Fig. 1) of the pyrometer which formed the subject of my last Friday evening lecture here, is placed within the crucible, B, and the spot of light, C, from the galvanometer, D, with which the junction is connected, indicates on the screen that the temperature is rising. You will observe that, as soon as the point marked 1010° is reached, energetic action takes place; the

(6) "La Metallurgie en France," 1894, p. 2.

temperature suddenly rising above the melting point of platinum, melts the thermo junction, and the spot of light swings violently; but if the crucible be broken open, you will see that a mass of metallic chromium has been liberated.

The use of alkaline metals in separating oxygen from other metels is well known. I cannot enter into its history here, beyond saying that if I were to do so, frequent reference to the honored names of Berzelius, Wohler and Winkler would be demanded. (7)

Mr. Vautin has recently shown that granulated aluminium may readily be prepared, and that it renders great service when employed as a reducing agent. He has lent me many specimens of rarer metals which have been reduced to the metallic state by the aid of this finely-granulated aluminium; and I am indebted to his assistant, Mr. Picard, who was lately one of my own students at the Royal School of Mines, for aid in the preparation of certain other specimens which have been isolated in my laboratory at the mint.

The experiment you have just seen enables me to justify a statement I made respecting the discriminating action which certain metals appear to exert. The relation of aluminium to other metals is very singular. When, for instance, a small quantity of aluminium is present in cast-iron, it protects the silicon, manganese and carbon from oxidation. (8) The presence of silicon in aluminium greatly adds to the brilliancy with which aluminium itself oxidizes and burns. (9) It is also asserted that aluminium, even in small quantity, exerts a powerful protective action against the oxidation of the silver-zinc alloy which is the result of the desilverisation of lead by zinc.

Moreover, heat aluminium in mass to redness in air, where oxygen may be had freely, and a film of oxide which is formed will protect the mass from further oxidation. On the other hand, if finely divided aluminium finds itself in the presence of an oxide of a rare metal, at an elevated temperature, it at once acts with energy and promptitude, and releases the rare metal from the bondage of oxidation. I trust, therefore, you will consider my claim that a metal may possess moral attributes has been justified. Aluminium, moreover, retains the oxygen it has acquired with great fidelity, and will only part with it again at very high temperatures, under the influence of the electric arc in the presence of carbon.

(A suitable mixture of red-lead and aluminium was placed in a small crucible heated in a wind-furnace, and in two minutes an explosion announced the termination of the experiment. The crucible was shattered to fragments.)

The aluminium loudly protests, as it were, against being entrusted with such an easy task, as the heat engendered by its oxidation had not to be used in melting a difficultly fusible metal like chromium, the melting point of which is higher than that of platinum.

It is admitted that a metal will abstract oxygen from another metal; the reaction is more exothermic than that by which the oxide to be decomposed was originally formed. The heat of formation of alumina is 391 calories, that of oxide of lead is 51 calories; so that it might be expected that metallic aluminium, at an elevated temperature, would readily reduce oxide of lead to the metallic state.

The last experiment, however, proved that the reduction of oxide of lead by aluminium is effected with explosive violence, the temperature engendered by the reduction being sufficiently high to volatilize the lead. Experiments of my own show that the explosion takes place with much disruptive power when aluminium reacts on oxide of lead *in vacuo*, and that if coarsely ground, fused litharge be substituted for red lead, the action is only accompanied by a rushing sound. The result is, therefore, much influenced by the rapidity with which the reaction can be transmitted throughout the mass. It is this kind of experiment which makes us turn with such vivid interest to the teaching of the school of St. Claire Deville, the members of which have rendered such splendid services to physics and metallurgy. They do not advocate the employment of the mechanism of molecules and atoms in dealing with chemical problems, but would simply accumulate evidence as to the physical circumstances under which chemical combination and dissociation take place, viewing these as belonging to the same class of phenomena as solidification, fusion, condensation, and evaporation. They do not even insist upon the view that matter is minutely granular, but in all cases of change of state, make calculations on the basis of work done, viewing changed "internal energy" as a quantity which should reappear when the system returns to the initial state.

A verse, of some historical interest, may appeal to them. It occurs in an old poem to which I have already referred as being connected with the *Roman de la Rose*, and it expresses nature's protest against those who attempt to imitate her works by the use of mechahical methods. The "argument" runs thus:—

"Comme Nature se complaint,
Et dit sa douleur et son plaint
A ung sot souffleur sophistique
Qui n' use que d'art mechanique."

If the "use of mechanical art" includes the study of chemistry on the basis of the mechanics of the atoms, I may be permitted to offer the modern school the following rendering of nature's plaint:—

How nature sighs without restraint,
And grieving makes her sad complaint
Against the subtle sophistry
Which trusts atomic theory.

An explosion such as is produced when aluminium and oxide of lead are heated in presence of each other, which suggested the reference to the old French verse, does not often occur, as in most cases the reduction of the rarer metals by aluminium is effected quietly.

Zirconium is a metal which may be so reduced. I have in this way prepared small quantities of zirconium from its oxide, and have formed a greenish alloy of extraordinary strength by the addition of 2-10 per cent. of it to gold, and there are many circumstances which lead to the belief that the future of zirconium will be brilliant and useful. I have reduced vanadium and uranium from its oxide by means of aluminium as well as manganese, which is easy, and titanium, which is more difficult. Tungsten, in fine specimens, is also before you—and allusion will be made subsequently to the uses of these metals. At present I would draw your attention to some properties of titanium which are of special interest. It burns with brilliant sparks in air; and as few of us have seen titanium burn, it may be well to burn a little in this flame. (Experiment performed.) Titanium appears to be, from the recent experiments of M. Moissan, the most difficultly fusible metal known; but it has the singular property of burning in nitrogen, it presents, in fact, the only known instance of vivid combustion in nitrogen. (10)

Titanium may be readily reduced from its oxide by the aid of aluminium. Here are considerable masses, sufficiently pure for many purposes, which I have recently prepared in view of this lecture.

(7) An interesting paper, by H. F. Keller, on the reduction of oxides of metals by other metals, will be found in the *Journal* of the American Chemical Society, December, 1894, page 833.

(8) Bull. Soc. Chim. Paris, vol. xi. 1894, p. 377.

(9) "Ditte Lecons sur les Metaux," part ii. 1891, p. 206.

(10) Lord Rayleigh has since stated that titanium does not combine with argon; and M. Guntz points out that lithium in combining with nitrogen produces incandescence. M. Moisson has also shown that uranium does not absorb argon.

The other method by which the rarer metals may be isolated is that which involves the use of the electrical furnace. In this connection the name of Sir W. Siemens should not be forgotten. He described the use of the electric arc-furnace in which the carbons were arranged vertically, the lower carbon being replaced by a carbon crucible, and in 1882 he melted in such a furnace no less than ten pounds of platinum during an experiment at which I had the good fortune to assist. It may fairly be claimed that the large furnaces with a vertical carbon in which aluminium and other metals are now reduced by the combined electrolytic action and tearing temperature of the arc, are the direct outcome of the work of Siemens.

In the development of the use of the electric arc for the isolation of the rare, difficultly fusible metals, Moissan stands in the front rank. He points out (Ann. de Chim et de Phys., vol. iv., 1895, p. 365) that Despretz (Comptes Rendus, vol. xxviii, p. 755, and vol. xxix, 1849, pp. 48, 545, 712) used in 1849, the heat produced by the arc of a powerful pile but Moissan was the first to employ the arc in such a way as to separate its heating effect from the electrolytic action it exerts. This he does by placing the poles in a horizontal position, and by reflecting their heat into a receptacle below them. He has shown in a series of classical researches that employing 800 amperes and 110 volts a temperatnre of at least 3,500 degrees may be attained, and that many metallic oxides which until recently were supposed to be irreducible may be readily made to yield the metal they contain. (The principal memoirs of M. Moissan will be found in the Comptes Rendus, vol. cxv., 1892, p. 1031; ibid. vol cxvi., 1893, pp. 347, 549, 1222, 1225, 1429; ibid. vol. cxix., 1894, pp. 15, 20, 935; ibid., vol. cxx., 1895, p. 290. The more important of the metals he has isolated are uranium, chromium, manganese, zirconium, molybdenum, tungsten, vanadium and titanium. There is an important paper by him on the various forms of the electric furnace in the Ann. de Chim. et de Phys. vol. iv., 1895, p. 365.

A support or base for the metal to be reduced is needed, and this is afforded by magnesia, which appears to be absolutely stable at the utmost temperatures of the arc. An atmosphere of hydrogen may be employed to avoid oxidation of the reduced metal, which, if it is not a volatile one, remains at the bottom of the crucible almost always associated with carbon—forming, in fact, a carbide of the metal. I want to show you the way in which the electric furnace is used, but unfortunately the reductions are usually very tedious, and it would be impossible to actually show you much if I were to attempt to reduce before you any of the rarer metals; but as the main object is to

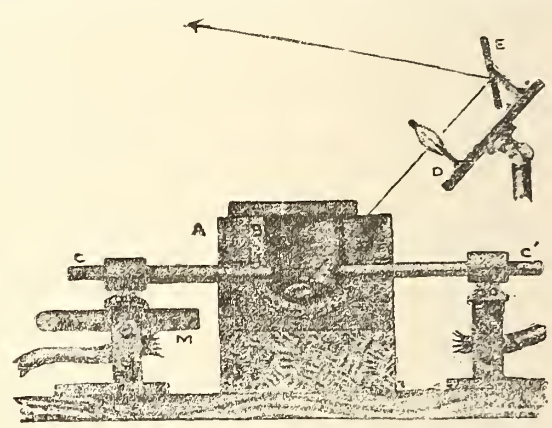

FIG. 2.

show you how the furnace is used, it may be well to boil some silver at a temperature of some 2500°, and subsequently to melt chromium in the furnace (Fig. 2). This furnace consists of a clay receptacle, A, lined with magnesia, B. A current of 60 amperes and 100 volts is introduced by the carbon poles, C, C; an electro-magnet, M, is provided to deflect the arc on to the metal to be melted. (By means of a lens and mirror, D, E, the image of the arc and of the molten metal was projected on to a screen. For this purpose it was found convenient to make the furnace much deeper than would ordinarily be the case.)

The result is very beautiful, but can only be rendered in dull tones by the accompanying illustrations (Figs. A B.) It may be well, therefore, to state briefly what is seen when the furnace is arranged for the melting of metallic chromium. Directly the current is passed, the picture reflected by the mirror, E, Fig. 2, shows the interior of the furnace (Fig. A) as a dark crater, the dull red poles revealing the metallic lustre and grey shadows of the metal beneath them. A little later these poles become tipped with dazzling white, and, in the course of a few minutes, the temperature rises to about 2500° C. Such a temperature will keep chromium well melted, though a thousand degrees more may readily be attained in a furnace of this kind. Each pole is soon surrounded with a lambent halo of the green-blue hue of the sunset, the central band of the arc changing rapidly from peach-blossom to lavender and purple. The

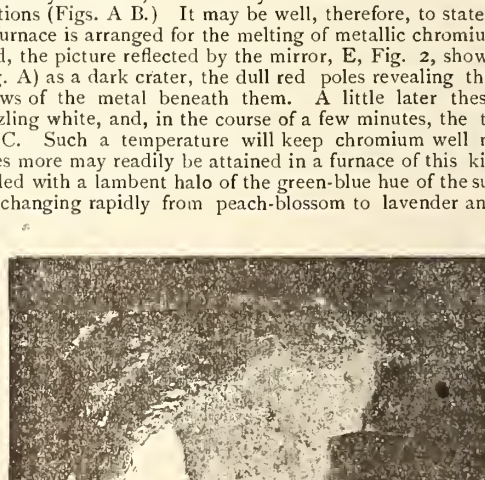

Fig. A—This represents the interior of the furnace containing molten chromium as is seen either by reflection on a screen or by looking into the furnace from above, the eyes being suitably protected by deeply tinted glasses.

Fig. B—In this case the arc was broken the instant before the photograph was taken. The furnace contained a bath of silver just at its boiling point. The reflection of the poles in the bath, the globules of distilled silver, and the drifting cloud of silver vapour, are well shown.

arc can then be lengthened, and as the poles are drawn farther and farther asunder, the irregular masses of chromium fuse in silver droplets, below an intense blue field of light, passing into green of lustrous emerald; then the last fragments of chromium melt into a shining lake, which reflects the glowing poles in a glory of green and gold, shot with orange hues. Still a few minutes later, as the chromium burns, a shower of brilliant sparks of metal are projected from the furnace, amid the clouds of russet or brown vapours which wreath the little crater; whilst if the current is broken, and the light dies out, you wish that Turner had painted the limpid tints, and that Ruskin might describe their loveliness.

The effect when either tungsten or silver (Fig. B) replaces chromium is much the same, but, in the latter case, the glowing lake is more brilliant in its turbulent boiling, and blue vapours rise to be condensed in the iridescent beads of distilled silver which stud the crater walls.

Such experiments will probably lend a new interest to the use of the arc in connection with astronomical metallurgy, for, as George Herbert said long ago:

"Stars have their storms even in a high degree,
As well as we";

and Lockyer has shown how important it is, in relation to such storms, to be able to study the disturbance in the various strata of the stellar or solar atmosphere. Layers of metallic vapour which differ widely in temperature can be more readily obtained by the use of the electrical furnace than when a fragment of metal is melted and volatilised by placing it in the arc on the lower carbon.

It must not be forgotten that the use of the electric arc between carbon poles renders it practically impossible to prepare the rare metals without associating them with carbon, often forming true carbides; but it is possible in many cases to separate the carbon by subsequent treatment. Moissan has, however, opened up a vast field of industrial work by placing at our disposal practically all the rarer infusible metals which may be reduced from oxides, and it is necessary for us now to consider how we may best enter upon our inheritance. Those members of the group which we have known long enough to appreciate are chromium and manganese, and these we have only known free from carbon for a few months. In their carburised state they have done excellent service in connection with the metallurgy of steel; and may we not hope that vanadium, molybdenum, titanium, and uranium will render still greater services. My object in this lecture is mainly to introduce you to these metals, which hitherto few of us have ever seen except as minute cabinet specimens, and we are greatly indebted to Mr. Moissan for sending us beautiful specimens of chromium, vanadium, uranium, zirconium, tungsten, molybdenum, and titanium. (These were exhibited.)

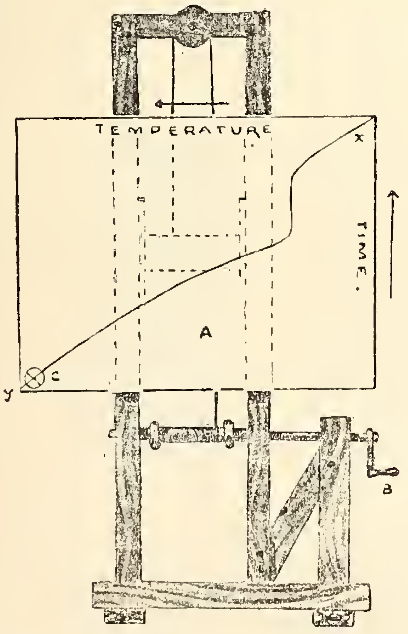

Fig. 3.

The question naturally arises: Why is the future of their usefullness so promising? Why are they likely to render better service than the common metals with which we have long been familiar? It must be confessed that as yet we know but little what services these metals will render when they stand alone; we have yet to obtain them in a state of purity, and have yet to study their properties, but when small quantities of any of them are associated or alloyed with other metals, there is good reason to believe that they will exert a very powerful influence. In order to explain this, I must appeal to the physical method of inquiry to which I have already referred.

It is easy to test the strength of a metal or of an alloy; it is also easy to determine its electrical resistance. If the mass stands these tests well, its suitability for certain purposes is assured; but a subtle method of investigation has been afforded by the results of a research entrusted to me by a committee of the Institution of Mechanical Engineers, over which Dr. Anderson, of Woolwich, presides. We can now gather much information as to the way in which a mass of metal has arranged itself during the cooling from a molten condition, which is the necessary step in fashioning it into a useful form; it is possible to gain insight into the way in which a molten mass of a metal or an alloy molecularly settles itself down to its work, so to speak, and we can form conclusions as to its probable sphere of usefulness.

The method is a graphic one, such as this audience is familiar with, for Prof. Victor Horsley has shown in a masterly way that traces on smoked paper may form the record of the heart's action under the disturbing influence caused by the intrusion of a bullet into the human body. I hope to show you by similar records the effect, which though disturbing is often far from prejudicial, of the introduction of a small quantity of a foreign element into the "system" of a metal, and to justify a statement which I made earlier, as to the applicability of physiological methods of investigation to the study of metals. In order that the nature of this method may be clear, it must

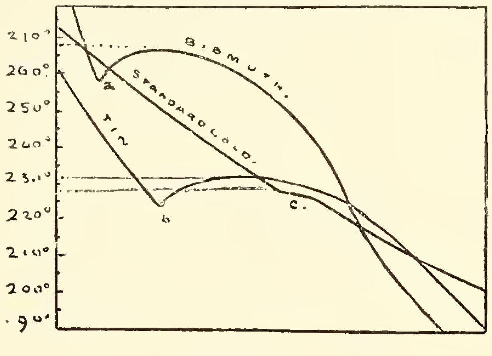

Fig. 4.

be remembered that if a thermometer or a pyrometer, as the case may be, is plunged into a mass of water or of molten metal, the temperature will fall continuously until the water or the metal begins to become solid; the temperature will then remain constant until the whole mass is solid, when the downward course of the temperature is resumed. This little thermo-junction is plunged into a mass of gold; an electric current is, in popular language, generated, and the strength of the current is proportional to the temperature to which the thermo-junction is raised; so that the spot of light from a galvanometer to which the thermo-junction is attached enables us to measure any thermal changes that may occur in a heated mass of metal or alloy.

It is only necessary for our purpose to use a portion of the long scale and to make that portion of the scale movable. Let me try to trace before you the curve of the freezing of pure gold. It will be necessary to mark the position occupied by the movable spot of light at regular intervals of time during which the gold is near 1045° C.—that is, while the metal is becoming solid. Every time a metronome beats a second, the white screen A (Fig. 3), a sheet of paper will be raised a definite number of inches by the gearing and handle, B, and the position successively occupied by the spot of light, C, will be marked by hand.

You see that the time-temperature curve, x, y, so traced is not continuous. The freezing-point of the metal is very clearly marked by the vertical portion. If the gold is very pure the angles are sharp, if it is impure they are rounded. If the metal had fallen below its freezing point without actually becoming solid, that is, if superfusion or surfusion had occurred, then there would be, as is often the case, a dip where the freezing begins, and then the temperature curve rises suddenly.

If the metal is alloyed with large quantities of other metals, then there may be several of these freezing points, as successive groups of alloys fall out of solution. The rough diagrammatic method is not sufficiently delicate to enable me to trace the subordinate points, but they are of vital importance to the strength of the metal or alloy, and photography enables us to detect them readily.

Take the case of the tin-copper series; you will see that as a mass of tin-copper alloy cools, there are at least two distinct freezing points. At the upper one the main mass of the fluid alloy became solid; at the lower, some definite group of tin and copper atoms fall out, the position of the lower point depending upon the composition of the mass.

Now turn to more complex curves taken on one plate by making the sensitised photographic plate seize the critical part of the curve, the range of the swing of the mirror from hot to cold being some sixty feet. The upper curve (Fig. 4) gives the freezing point of bismuth, and you see that surfusion, a, is clearly marked, the temperature at which bismuth freezes being 268°C. The lower curve marked "tin," represents the freezing point of that metal, which we know is 231°C, and in its surfusion, B, is also clearly marked. The curve marked standard gold contains a subordinate point, C, which you will observe is lower than the freezing point of tin, and it is caused by the solidification of a small portion of bismuth, which alloyed itself with some gold atoms, and remained fluid below the freezing point not only of bismuth itself but of tin. Now gold with a low freezing point in it like this is found to be very brittle, and we are in a fair way to answer the question why $\frac{2}{10}$ per cent. of zirconium doubles the strength of gold, while $\frac{2}{10}$ per cent. of thallium, another rare metal, halves the strength. In the case of the zirconium the subordinate point is very high up, while in the case of the thallium it is very low down. So far as my experiments have as yet been carried, this seems to be a fact which underlies the whole question of the strength of metals and alloys. If the subordinate point is low, the metal will be weak; if it is high in relation to the main setting point, then the metal will be strong, and the conclusion of the whole matter is this:— The rarer metals which demand for their isolation from their oxides either the use of aluminium or the electric arc, never, so far as I can ascertain, produce low freezing points when they are added in small quantities to those metals which are used for constructive purposes. The difficultly fusible rarer metals are never the cause of weakness, but always confer some property which is precious in industrial use. How these rarer metals act, why the small quantities of the added rare metals permeate the molecules, or, it may be the atoms, and strengthen the metallic mass, we do not know; we are only gradually accumulating evidence which is afforded by this very delicate physiological method of investigation.

As regards the actual temperatures represented by points on such curves, it will be remembered that the indications afforded by the recording pyrometer are only relative, and that gold is one of the most suitable metals for enabling a high, fixed point to be determined. There is much trustworthy evidence in favor of the adoption of 1045° as the melting point hitherto accepted for gold. The results of recent work indicate, however, that this is too low, and it may prove to be as high as 1061·7, which is the melting point given by Heycock and Neville* in the latest of their admirable series of investigations to which reference was made in my Friday evening lecture of 1892.

It may be well to point to a few instances in which the industrial use of such of the rarer metals, as have been available in sufficient quantity, is made evident. Modern developments in armour-plate and projectiles will occur to many of us at once. This diagram (Fig. 5) affords a rapid view of the progress which has been made, and in collecting the materials for it from various sources, I have been aided by Mr. Jenkins. The effect of projectiles of approximately the same weight, when fired with the same velocity against six-inch plates, enables comparative results to be studied, and illustrates the fact that the rivalry between artillerists who design guns, and metallurgists who attempt to produce both impenetrable armour-plates and irresistible projectiles, forms one of the most interesting pages in our national history. When metallic armour was first applied to the sides of war vessels, it was of wrought iron, and proved to be of very great service by absolutely preventing the passage of ordinary cast-iron shot into the interior of the vessel, as was demonstrated during the American civil war in 1866. It was found to be necessary, in order to pierce the plates, to employ harder and larger projectiles than those then in use, and the chilled cast-iron shot with which Colonel Palliser's name is identified proved to be formidable and effective. The point of such a projectile was sufficiently hard to retain its form under impact with the plate, and it was only necessary to impart a moderate velocity to a shot to enable it to pass through the wrought-iron armour (Fig. 5).

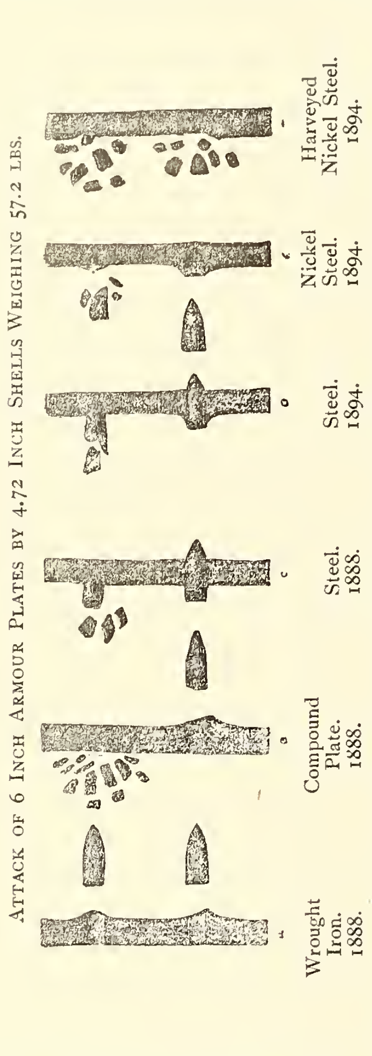

Fig. 5—The upper series of projectiles are Palliser chilled-iron shells, and the lower are chrome-steel. In each case the velocity of the projectile is approximately 1640 foot seconds, and the energy 1073 foot-tons.

It soon became evident that in order to resist the attack of such projectiles with a plate of any reasonable thickness, it would be necessary to make the plate harder, so that the point of the projectile should be damaged at the moment of first contact, and the reaction to the blow distributed over a considerable area of the plate. This object could be attained by either using a steel plate in a more or less hardened condition, or by employing a plate with a very hard face of steel, and a less hard but tougher back. The authorities in this country during the decade, 1880-90, had a very high opinion of plates that resisted attack without the development of through cracks, and this led to the production of the compound plate. The backs of these plates (B, Fig. 5) are of wrought iron, the fronts are of a more or less hard variety of steel, either cast on, or welded on by a layer of steel of an intermediate quality cast between the two plates. Armour-plates of this kind differ in detail, but the principle of their construction is now generally accepted as correct.

Such plates shown by plate B, resisted the attack of large Palliser shells admirably, as when such shells struck the plate they were damaged at their points, and the remainder of the shell was unable to perforate the armour against which it was directed. An increase in the size of the projectiles led, however, to a decrease in the resisting power of the plates, portions of the hard face of which would at times be detached in flakes from the junction of the steel and the iron. An increase in the toughness of the projectiles by a substitution of forged chrome-steel for chilled iron (see lower part of plate B), secured a victory for the shot, which was then enabled to impart its energy to the plate faster than the surface of the plate itself could transmit the energy to the back. The result was that the plate was overcome, as it were, piecemeal ; the steel surface was not sufficient to resist the blow itself, and was shattered, leaving the projectile an easy victory over the soft back. The lower part of plate B, (in Fig. 5), represents a similar plate to that used in the Nettle trials of 1888. (11) It must not be forgotten in this connection, that the armour of a ship is but little likely to be struck twice by heavy projectiles in the same place, although it might be by smaller ones.

Plates made entirely of steel, on the other hand, were found, prior to 1888, to have a considerable tendency to break up completely when struck by the shot. It was not possible on that account, to make their faces as hard as those of compound plates ; but while they did not resist the Palliser shot nearly so well as the rival compound plate, they offered more effective resistance to steel shot (see lower part of plate C, Fig. 5).

It appears that Berthier recognized in 1820, the great value of chromium when alloyed with iron ; but its use for projectiles, although now general, is of comparatively recent date, and these projectiles now commonly contain from 1.2 to 1.5 per cent. of chromium, and will hold together even when they strike steel plates at a velocity of 2,000 ft. per second (12) (see lower part of plate D) ; and unless the armour plate is of considerable thickness, such projectiles will even carry bursting charges of explosives through it. (The behaviour of a chromium steel shell, made by Mr. Hadfield, was dwelt upon, and the shell was exhibited.)

It now remained to be seen what could be done in the way of toughening and hardening the plates so as to resist the chrome-steel shot. About the year 1888, very great improvements were made in the production of steel plates. Devices for hardening and tempering plates were ultimately obtained, so that the latter were hard enough throughout their substance to give them the necessary resisting power without such serious cracking as had occurred in previous ones. But in 1889 Mr. Riley exhibited at the meeting of the Iron and Steel Institute a thin plate that owed its remarkable toughness to the presence of nickel in the steel. The immediate result of this was that plates could be made to contain more carbon, and hence be harder, without at the same time having increased brittleness ; such plates, indeed, could be water hardened and yet not crack.

The plate E (Fig. 5), represents the behaviour of nickel-steel armour. It will be seen that it is penetrated to a much less extent than in the former case ; at the same time there is entire absence of cracking.

Now, as to the hardening processes. Evrard had developed the use of the lead bath in France, while Captain Tressider (Weaver, "Notes on Armour," Journal U. S. Artillery, Vol. III, 1894, p. 417), had perfected the use of the water-jet in England for the purpose of rapidly cooling the heated plates. The principle adopted in the design of the compound plates has been again utilized by Harvey, who places the soft steel or nickel-steel plate in a furnace of suitable construction, and covers it with carbonaceous material such as charcoal, and strongly heats it for a period, which may be as long as 120 hours. This is the old Sheffield process of cementation, and the result is to increase the carbon from 0.35 per cent. in the body of the plate to 0.6 per cent., or even more at the front surface, the increase in the amount of carbon only extending to a depth of two or three inches in the thickest armour.

The carburized face is then "chill-hardened," the result being that the best chrome-steel shot are shattered at the moment of impact, unless they are of very large size as compared with the thickness of the plate. The interesting result was observed lately ("Brassey's Naval Annual," 1894, p. 367) of shot doing less harm to the plate and penetrating less when its velocity was increased beyond a certain value, a result due to a superiority in the power of the face of the plate to transmit energy over that possessed by the projectile, which was itself damaged, when a certain rate was exceeded. At a comparatively low velocity the point of the shot would resist fracture, but the energy of the projectile is not then sufficient to perforate the plate, which would need the attack of a much larger gun firing projectile at a lower velocity.

The tendency today is to dispense with nickel, and to use ordinary steel, "Harveyed" ; (Engineering, Vol. LVII, 1894, pp. 465, 530, 595), this gives excellent six-inch plates, but there is some difference of opinion as to whether it is advantageous to omit nickel in the case of very thick plates, and the problem is now being worked out by the method of trial. Probably, too, the Harveyed plates will be much improved by judicious forging after the process, as is indicated by some recent work done in America. The use of chromium in the plates may lead to interesting results.

Turn for a moment to the *Majestic* class of ships, the construction of which we owe to the genius of Sir William White, to whom I am indebted for a section representing the exact size of the protection afforded to the barbette of the *Majestic*. (This section was exhibited and is shown as reduced to the diagram Fig. 6.) Her armor is of the Harveyed steel, which has hitherto proved singularly resisting to chromium projectiles.

In this section, A represents a 14-inch Harveyed steel armor plate ; B, a 4-inch teak backing ; C, a 1¼-inch steel plate ; D, ½-inch steel frames ; and E, ½-inch steel linings.

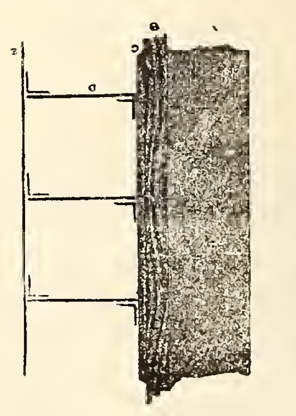

Fig. 6—Section of the Barbette of the Majestic.

It will, I trust, have been evident that two of the rarer metals, chromium and nickel, are playing a very important part in our national defences ; and if I ever lecture to you again, it may be possible for me to record similar triumphs for molybdenum, titanium, vanadium, and others of these still rarer metals.

Here is another alloy, for which I am indebted to Mr. Hadfield. It is iron alloyed with 25 per cent. of nickel, and Hopkinson has shown that its density is permanently reduced by two per cent. by an exposure to a temperature of 30°—that is, the metal expands at this temperature.

*Trans. Chem. Soc.," Vol. LXVII, 1895, p. 160.

(11) Proceedings, Institution of Civil Engineers, 1889, Vol. XCVIII, p. 1, et. seq.
(12) Journal U. S. Artillery, 1893, Vol. II, p. 497.

Supposing, therefore, that a ship-of-war was built in our climate of ordinary steel, and clad with some three thousand tons of such nickel-steel armor, we are confronted with the extraordinary fact that if such a ship visited the Arctic regions, it would actually become some two feet longer, and the shearing which would result from the expansion of the armor by exposure to cold would destroy the ship. Before I leave the question of the nickel-iron alloys, let me direct your attention to this triple alloy of iron, nickel, and cobalt in simple atomic proportions. Dr. Oliver Lodge believes that this alloy will be found to possess very remarkable properties; in fact, as he told me, if nature had properly understood Mendeleef, this alloy would really have been an element. As regards the electrical properties of alloys, it is impossible to say what services the rarer metals may not render; and I would remind you that "platinoid," mainly a nickel-copper alloy, owes to the presence of a little tungsten its peculiar property of having a high electrical resistance which does not change with temperature.

One other instance of the kind of influence the rarer metals may be expected to exert is all that time will permit me to give you. It relates to their influence on

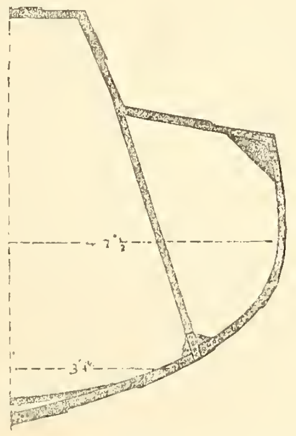

Fig. 7—Half Section Midship of Aluminium Torpedo Boat.

aluminium itself. You have heard much of the adoption of aluminium in such branches of naval construction as demand lightness and portability. During last autumn, Messrs. Yarrow completed a torpedo-boat which was built of aluminium alloyed with 6 per cent. of copper. Her hull is 50 per cent. lighter, and she is 3½ knots faster than a similar boat of steel would have been, and, notwithstanding her increased speed, is singularly free from vibration.

Her plates are $\frac{1}{16}$-inch thick, and ⅛-inch where greater strength is needed. It remains to be seen whether copper is the best metal to alloy with aluminium. Several of the rarer metals have already been tried, and among them titanium. Two per cent. of this rare metal seems to confer remarkable properties on aluminium, and it should do so according to the views I have expressed, for the cooling curve of the titanium-aluminium alloy would certainly show a high subordinate freezing point.

Hitherto I have appealed to industrial work, rather than to abstract science, for illustrations of the services which the rarer metals may render. One reason for this is that at present we have but little knowledge of some of the rarer metals apart from their association with carbon. The metals yielded by treatment of oxides in the electric arc are always carburized. There are, in fact, some of the rarer metals which we, as yet, can hardly be said to know except as carbides. As the following experiment is the last of the series, I would express my thanks to my assistant, Mr. Stansfield, for the great care he has bestowed in order to ensure their success. Here is the carbide of calcium which is produced by heating lime and carbon in the electric arc. It possesses great chemical activity, for if it is placed in water the calcium seizes the oxygen of the water, while the carbon also combines with the hydrogen, and acetylene is the result, which burns brilliantly. (Experiments shown.) If the carbide of calcium be placed in chlorine water, evil smelling chloride of carbon is formed.

In studying the relations of the rarer metals to iron, it is impossible to dissociate them from the influence exerted by the simultaneous presence of carbon; but carbon is a protean element—it may be dissolved in iron, or it may exist in iron in any of the varied forms in which we know it when it is free. Matthiessen, the great authority on alloys, actually writes of the "carbon-iron alloys." I do not hesitate, therefore, on the ground that the subject might appear to be without the limits of the title of this lecture, to point to one other result which has been achieved by M. Moissan. Here is a fragment of pig-iron highly carburized; melt it in the electric arc in the presence of carbon, and cool the molten metal suddenly, preferably by plunging it into molten lead. Cast-iron expands on solidification, and the little mass will become solid at its surface and will contract; but when, in turn, the still fluid mass in the interior cools, it expands against the solid crust, and consequently solidifies under great pressure. Dissolve such a mass of carburized iron in nitric acid to which chlorate of potash is added; treat the residue with caustic potash, and submit it to the prolonged attack of hydrofluoric acid, then to boiling sulphuric acid, and finally fuse it with potash, to remove any traces of carbide of silicon, and you have carbon left, but—in the form of *diamonds.*

If you will not expect to see too much, I will show you some diamonds I have prepared by strictly following the directions of M. Moissan. As he points out, these diamonds, being produced under stress, are not entirely without action on polarized light, and they have, sometimes, the singular property of flying to pieces like Rupert's drops when they are mounted as preparations for the microscope. (The images of many small specimens were projected on the screen from the microscope, and Fig. 8, E, shows a sketch of one of these. The largest diamond yet produced by M. Moissan is 0.5 millimetre in diameter.)

A, (Fig. 8) represents the rounded, pitted surface of a diamond, and B, a crystal of a diamond from the series prepared by M. Moissan, drawings of which illustrate his paper. (*Comptes Rendus*, Vol. CXVIII, 1894, p. 324). The rest of the specimens, C to F, were obtained by myself by the aid of his method as above described. C represents a dendritic growth apparently composed of hexagonal plates of graphite, while D is a specimen of much interest, as it appears to be a hollow sphere of graphitic carbon, partially crushed, in such examples are very numerous, and the surfaces are covered with minute round graphitic pits and prominences of great brilliancy. Specimen E (which as already stated, was one of a series shown to the audience) is a broken crystal, probably a tetrahedron, and is the best crystallised specimen of diamond I have as yet succeeded in preparing. Minute diamonds, similar to A, may be readily produced, and brilliant fragments, with the lamella structure shown in F, are also often met with.

The close association of the rarer metals and carbon and their intimate relations with carbon, when they are hidden with it in iron, enabled me to refer to the production of the diamond, and afford a basis for the few observations I would offer in conclusion. These relate to the singular attitude towards metallurgical research main-

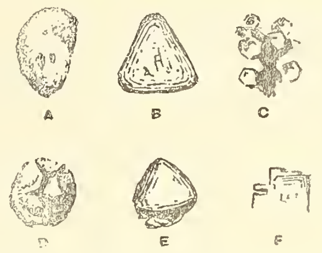

Fig. 8—Preparations for the Microscope of Diamonds and other forms of Carbon obtained from Carbonized Iron.

tained by those who are in a position to promote the advancement of science in this country. Statements respecting the change of shining graphite into brilliant diamond are received with appreciative interest; but on the other hand the vast importance of effecting similar molecular changes in metals is ignored.

We may acknowledge that "no nation of modern times has done so much practical work in the world as ourselves, none has applied itself so conspicuously or with such conspicuous success to the indefatigable pursuit of all those branches of human knowledge which give to man his mastery over matter.—(*The Times*, February 22, 1895). But it is typical of our peculiar British method of advance to dismiss all metallurgical questions as "industrial," and leave their consideration to private enterprise.

We are fortunately to spend, I believe, eighteen millions this year in our navy, and yet the nation only endows experimental research in all branches of science with four thousand pounds. We rightly and gladly spend a million on the *Magnificent*, and then stand by while manufacturers compete for the privilege of providing her with the armour-plate which is to save her from disablement or destruction. We, as a nation, are fully holding our own in metallurgical progress, but we might be doing so much more. Why are so few workers studying the rarer metals and their alloys? Why is the crucible so often abandoned for the test-tube? Is not the investigation of the properties of alloys precious for its own sake, or is our faith in the fruitfulness of the results of metallurgical investigation so weak that, in its case, the substance of things hoped for remains unsought for and unseen in the depths of obscurity in which metals are left.

We must go back to the traditions of Faraday, who was the first to investigate the influence of the rarer metals upon iron, and to prepare the nickel-iron series, of which so much has since been heard. (In the development of the use of these alloys; the Societé Ferro-Nickel, and Les Usines du Creusot, deserve special mention). He did not despise research which might possibly tend to useful results, but joyously records his satisfaction at the fact that a generous gift from Wollaston of certain of the "scarce and more valuable metals" enabled him to transfer his experiments from the laboratory in Albemarle Street to the works of a manufacturer at Sheffield.

Faraday not only began the research I am pleading for tonight, but he gave us the germ of the dynamo, by the aid of which as we have seen the rarer metals may be isolated. If it is a source of national pride that research should be endowed apart from the national expenditure, let us, while remembering our responsibilities, rest in the hope that metallurgy will be well represented in the laboratory which private munificence is to place side by side with our historic Royal Institution.

MINING IN NOVA SCOTIA.

(From our own Correspondent.)

A considerable amount of dissatisfaction has been caused amongst the gold miners here by an error in the official "Blue Book."

The error appears to have been brought to light by the figures given in Mr. Mason's paper on Gold Mining in Nova Scotia published in our last issue; some of the gold miners in the Stormont district challenged Mr. Mason for his authority and he referred them to the "Blue Book," and thus the error was brought to light nine months after the "Blue Book" was published. This little incident shows very clearly how much interest the mining fraternity take in the official report of the mining industry of the province. That so glaring an error has been allowed to pass unnoticed for nine months proves beyond a doubt that the official report has degenerated to such an extent that the miners either treat it with silent contempt, or else think it is a waste of time to look through it. This state of things is far from what it ought to be; the official report should be a means of bringing the resources of the province to the notice of capitalists, and we would strongly urge the Government to seek the co-operation of the gold miners in producing the next volume. Unless some decided move is made the gold resources of this province (which are acknowledged to be promising by experts on both sides of the water) will continue to be developed in the same hum-drum style as heretofore.

We are pleased to report that Mr. Pushie *et al.* are pushing (no joke meant) forward their plant for treating tailings and concentrates. Some expensive machinery is being made for them by the Truro Foundry Co., and we hope in the not very distant future to be able to report that a complete bromination plant is in operation. The plant will consist of a Collins mill and concentrator, while the concentrates will be roasted in a horseshoe furnace and then subjected to bromination in barrels. Too much stress cannot be laid on the advantage this will be to the province if brought to a successful issue, the gold miners will have a place where they can send their concentrates, and more economical methods of treating the ore will become universal. Messrs. John W. Mieir and E. S. Godfrey, of New York, are superintending the erection of machinery, and are engaged in taking samples of the various tailing dumps throughout the province with a view to purchasing.

The output of ore from the Torbrook iron mines for the month of October has exceeded all previous records, 8,400 tons of ore were produced and shipped during the month, half going to Londonderry and half to Ferrona.

The Kent *v.* Borrodaile "gold mine" suit has been finished in the Supreme Court. His Lordship reserved judgment.

The 12-inch pipes for the new Gas Co. in Halifax are being supplied by the Londonderry Iron Co.

We understand that a new company has been formed to work the Coxheath copper mine, C.B. Mr. C. M. Odell has been employed to make surveys for a new route for a railway from the mines to Campbell's Brook on the I.C.R. Dr. Peters, of Boston, and Mr. Brown, of Chicago, are preparing plans for a reduction works, which will be situated on the Grantmyre property.

Mr. John Johnston has been compelled through ill-health to resign the management of the Dominion colliery, and will take over the lighter duties of manager of the Gowrie colliery.

Mr. James Wilkes, of Montreal, has been to the Londonderry Iron Works, superintending the fitting up of furnaces for the manufacture of puddled bar iron, which the company intend producing shortly.

We regret to have to chronicle the death of Professor George Lawson, whose name has been intimately associated with the advancement of science in this province for upwards of thirty years.

We have had a call from Mr. B. M. Davidson recently who had just returned from starting the new mill on the Barasois property at Wine Harbor. Mr. Davidson reports the property looking very well. He brought up a 33 oz. brick, the result of a week's work.

The Oxford Mining Co. have started work stripping the surface preparatory to quarrying. This property is to be worked by an open cut, the ore being taken to the mill by a cable hoist.

At a general meeting of the Dominion Smelting and Refining Co., held in Halifax on Nov. 14th, a resolution was passed to wind up the company. Mr. Hardman (who has had charge of the prospecting latterly) stated in his report that the work done was not of a sufficiently encouraging nature to warrant further outlay. In all about $5,000 have been spent in arriving at this conclusion. We cannot help thinking that a more satisfactory result might have been obtained if an expert lead-miner had been employed to superintend the prospecting at the start. According to previous reports, by Dr. Gilpin and Capt. Evans, there is a large body of ore in sight which Dr. Gilpin estimated would run 15% of galena. Assuming this to be the case, we think that if this body had been cut through and a cheap hand-dressing plant erected to treat it, sufficient lead ore might have been obtained to pay for further prospecting.

Although the gold returns for the year ending Sept. 30th, 1895, are considerably below the average. The new official year is starting with considerable promise. We expect to hear good accounts from Modstock, Malega, Goldenville, Wine Harbor, Oxford and Central Rawdon; while there is no reason to anticipate any falling off in those mines which have mainly been instrumental in making up this year's production.

The property of the Nova Scotia Gold Mines, Limited, was sold by the sheriff on Nov. 16th to Mr. A. P. McQuarrie for $5,000. There were 26 attachments against the property amounting in all to $5,074.14.

The North Brookfield Gold Mining Co. produced a brick of 321 oz. last month.

A considerable amount of prospecting is being done in the neighborhood of Gold River and some very fine quartz has been found. We expect to hear of some very good returns from this part of the province next year. Mr. T. N. Baker, with a two-stamp mill returned 54 oz. 6 dwt. from 30 tons of quartz.

The Sherbrooke district produced 249 oz. of gold from 524 tons of quartz.

The Golden Lode mine produced 224 oz. 6 dwt. from 25 tons of quartz.

Fifteen Mile Stream continues its fine record; 385 oz. 1 dwt. of gold were obtained last month from 580 tons of quartz.

The Richardson mine produced 154 oz. of gold last month from 892 tons of quartz.

A number of gold areas in Tangiers district, the property of Dr. Jenkins, are to be sold by the sheriff.

MINING IN BRITISH COLUMBIA.

The Waverley Hydraulic Co's mine on Grouse creek made a fair cleanup this season and much satisfaction is expressed by the management that the old mine is gradually working out its salvation. For seventeen years hydraulicing has been going on season after season and this year only bed rock was reached. It is expected from now on to make an increase in each year's production.

Whittier's ditch which was contracted to Chinamen is nearly completed. It is nearly nine miles long and there will be capacity for about 3,000 inches of water.

The Forrest Rose and St. George Hydraulic Company have finished piping and have commenced to cleanup their summer's run and from all indications the season has been a very satisfactory one.

The contractors for the tunnel for the Gold Fields Company, Messrs. Bossi and Navard, are still pushing work with vigor and although handicapped by soft ground and water enough for a sluice head they are making over six feet for every 24 hours. The tunnel mentioned was designed to drain the ground to be worked by Whittier's hydraulic lift and one can get some idea of the immense amount of water the old timers had to contend with in their efforts to bottom the lower end of William's creek. The old Ballarat was the lowest mine to be worked down the creek and although expensive to work was very rich and where the owners were compelled to leave off on account of the difficulties of contending with the water, it was as rich as any of the ground above. The tunnel now being run is under contract for 2,600 feet. It is expected that when the distance named in the contract is reached that a depth of about 140 feet will have been attained, but it is expected to reach bedrock at about that distance.

Wilcox and Hancock who are drifting on the old Cy Roe and Frank Orr property, are in about 200 feet and are steadily taking out pay. Last summer during the wet weather they had a bad cave which interfered with their work for some weeks, but as the ground dried out they were able to get around their cave and resume their work on a profitable basis. The ground being worked by these men is in a locality that has been travelled over for 30 years by everybody who has gone to and from Barkerville. It is ground that is not as rich as some of the old claims, but there is a considerable extent of it and there should be no difficulty in working it. The entrance to the tunnel is near the flat on Willow river and quickly runs under the road and to bed rock.

The Short Bend hydraulic mine on Grouse creek, which is managed by Anthony McAlinden, made the most successful cleanup this season that has been achieved for years, about 150 ounces being the result. The mine is on the old works where in early days fabulous sums were taken out, but on getting away from the old bed of Grouse creek the pay was lost and for a number of years the mine did not pay expenses, in fact ran behind. Several old claims on Grouse creek paid very high. A nugget was picked up in the Short Bend last summer by a tenderfoot who was poking around the ground sluices which weighed out about $46 worth of gold. He was spied by the foremon, who quickly took the nugget away from him. Miners should be very careful how they allow strangers to ransack their ground sluices, as there is no telling what chunks of gold are lying around. In this instance two other parties, Messrs. Ramos and Cameron, in addition to the foreman, saw the nugget picked up. It was a very handsome smooth piece of gold near the shape of an egg.

Last Saturday Charles S. Voorhees, president of the Robert E. Lee Mining Co., made the second payment of $6,000 on the Lee and Maid of Erin. The recipients of the money were William Dunn and Michael Sullivan, who located these two mines last fall. They were bonded for $36,000 by the owners last April to John M. Burke and Clayton Miller, who subsequently transferred them to the Robt. E. Lee Gold Mining Company, in which both hold large interests. Messrs. Dunn and Sullivan are among the fortunate prospectors of the camp. Both the Lee and Maid of Erin are fine properties and will always hold high rank in the Trail Creek district. John M. Burke will give his personal attention to their development, and no doubt the judgment he exercised in buying them will be vindicated. The new steam hoist, pump and power drills will be here in a few days. As soon as they can be got in place the work of raising ore from the shaft of the Maid of Erin will begin, and one more shipper will be added to the list. The Lee Company is in first-class financial condition, and it would be gratifying to know that some of the other good properties of the camp were in such competent hands. Much of the credit for the sound condition of the Lee Company is due to H. L. Wilson, the treasurer. Mr. Wilson is a very careful, painstaking man, and the company is fortunate in having him for its treasurer.—*Tribune.*

Very good progress is now being made in sinking the Le Roi shaft and the work will soon be completed. The finest ore ever taken from the Le Roi is being found in this shaft nearly 400 feet below the surface. One block weighing 80 pounds was blown off last week and when tested ran $80 in gold. It is much impregnated with quartz and presents a beautiful appearance. The piece will be taken to Spokane and placed on exhibition. It is an encouraging fact that quartz increases in the ore of this camp as deep workings are opened up.—*Rossland Miner.*

The preliminary steps have been taken for the establishment of a 200-ton matteing plant in the immediate vicinity of Rossland for the reduction of Trail Creek ores. This comes as a result of the visit made here recently by Mr. Larsen of Colorado. Mr. Larsen spent a week in an investigation of the ores of this camp. He became thoroughly convinced that they are subject to concentration by the process now in use in the bi-metallic smelter at Leadville. Mr. Larsen came to the conclusion he could throw from 6 to 10 tons of ore into one of copper matte at a cost not to exceed $4 per ton. He went from Rossland to Spokane, where he laid plans before several substantial mine owners who have Trail Creek interests and he met with reasonable encouragement. It has been determined to form a company with a capital of $250,000 and to erect a plant with a capacity of 200 tons a day. The site for the works has not yet been selected, but it will probably be not far from Center Star gulch.—*Miner.*

The sale of the Cliff mine and the St. Elmo Consolidated to the Lillooet, Fraser River and Cariboo Gold Fields, Ltd., of which Frank S. Barnard, M.P., of Victoria, is the representative, is one of the largest mining transactions that has ever taken place in the Northwest, says the Rossland *Record.* The consideration of the sale of the sale of the Cliff is $150,000, and for the St. Elmo Consolidated is $75,000 in the following instalments:—$1,000 cash, $34,000 December 31st, $50,000 June 1st, 1896, and the final payment $140,000 in December of next year.

The Cliff is one of the most thoroughly developed properties in the Trail Creek district, the lower tunnel being 142 feet, 95 feet of which being in ore that will run $12 to the ton. The upper tunnel is in 150 feet in ore said to be valued at $25 a ton; a shaft 26 feet is also in ore, besides 125 feet of cross-cuts and seven open cuts in ore, making in all about 453 feet of development. The best ore is in the upper tunnel. Col. Wharton says he is looking for a chute of ore which is plainly visible from the surface which will go not less than $40 to the ton. The run is 4 feet solid, carrying 20 per cent. of copper.

The Cliff was located in September, 1893, by Guy Reeder, who received a grub stake from Charles Crossman. Col. Wharton and John R. Cook bought Reeder's interest, and Wharton Bros. the interest held by Crossman in the spring of 1894. No development had been done up to that date aside from the assessment work. Col. Wharton had faith in the mine from the start and believed he had a fortune in it, and when he was offered nearly $100,000 for it last summer his friends thought he was making a mistake. He thought not, and the sale just made justified his judgment.

The Columbia River Hydraulic Mining Co. have given F. G. Kegler a contract for some $3,000 worth of work on their property in the Big Bend, which will be done during the winter. The lumber will be cut in the vicinity, and five men employed on the job. Two hydraulics and 3,400 feet of pipe have already been ordered.

The shipments of coal from Nanaimo and Wellington last month were:

	Tons.
New Vancouver Coal Co.	16,677
Wellington	19,535
Union	17,450
Total	53,662

The shipments for September amounted to 55,676 tons or 2,014 tons more than those in October.

The bullion and ore shipments from the Slocan district at last report were:

	Tons.	Value.
Smelter, Pilot Bay	140	$14,000
Le Roi mine, Rossland	573	28,650
Josie Mine, Rossland	128	6,400
War Eagle Mine, Rossland	70	3,500
Goodenough Mine, Sandon	20	2,000
Wellington Mine, Slocan District	17	1,700
Alamo Mine, Three Forks	17	1,700
Total	965	$57,950
Total so far for 1895	25,242	$1,977,450

A. B. Hendryx, of the Pilot Bay Smelter, says that "the compressor and drills at the Blue Bell mine will be ready for operation in about twenty days. It is the intention to keep one of the drills continuously at work on the vein of copper on the lower level. Many things are hoped for from this working of the copper. It assays well, and we shall determine what there is in it. There is another vein of copper-bearing ore in the mine which carries one ounce of silver to each per cent. of copper. We are taking out large quantities of ore every day from the Blue Bell and sending it to the smelter. At the smelter the work is going on much as usual. We are using ore from the Skyline and Number One mine at Ainsworth; in fact, we are taking their entire product. The Hooker Creek district will be heard from. The owners of one claim sent down some fine ore to the smelter, and the returns were a surprise to them all. Another season will witness many new and rich discoveries in the West Kootenay."

LEGAL.

Fraser River Mining and Dredging Co., Ltd. v. Gallagher—Important Decision to Company Promoters.

Chief Justice Davie's judgment in this celebrated case, which was heard recently in the Supreme Court of British Columbia, is as follows:—

In Broderip v. Salomon, 12 R. 89, a company composed only of Salomon and his relatives had been formed under the Companies Act, 1862, for the ostensible purpose of purchasing and carrying on Salomon's business, but with the manifest object of swindling everyone who might become connected with it, outside of the Salomons. At the instance of creditors, the sale of Salomon's business to the company was declared to be fictitious, and Salomon was directed to indemnify the company against its debts and liabilities. It has been stoutly contended that the Fraser River Company was a mere scheme to swindle subsequent shareholders, and that acting upon priuciples similar to Salomon v. Broderip, Alworth, who had purchased a controlling interest in the shares of the company, at a comparatively insignificant price, should be ordered at the suit of subsequent shareholders to contribute to the assets of the company, the difference between the nominal value of the shares and what he paid for them. But I am of opinion that, so far from the formation of the company being a swindle on the part of Alworth, the company, so far as he was concerned, was formed with perfect honesty of purpose, that he put his money (which was the principal money furnished) into the concern in good faith, with the object of developing what he believed to be a valuable property, and that the advantages complained of in this action were purchased *bona fide* only for his own protection, and to guard against the possibility of his interests being sacrificed by those who had contributed nothing, or next to nothing. The facts of the case are these:

C. S. Bailey, W. Bailey, T. J. Beatty, W. H. Gallagher and James Tallyard had applied for a lease from the Government of 42 miles of the Fraser river, for the purpose of dredging for gold. Being without funds for entering upon the work, they made an agreement, dated 9th February, 1894, with C. E. Crockett, who claimed to have experience in such enterprises, to furnish $25,000—$12,000 within 90 days and the remainder from time to time as required, upon condition that a company was to be formed with a nominal capital of $2,500,000, divided into 250,000 shares of $10 each, of which Crockett was to receive 51 per cent. He was to be the general manager of the company, and was to expend the money in building a steam scow and completing and equipping pumps and machinery necessary to successfully operate the claims, and to be at work inside of 90 days. By a supplementary agreement of the same date, in consideration of $54 (receipt acknowledged), Bailey and the other holders of the lease assigned to Crockett an undivided one-sixth interest therein, Crockett agreeing to pay one-sixth of all future expenses in connection with the claims, agreeing to vest in the Anglo-American Mining Company the use of any patents he had for mining purposes and to act as general manager of the company, giving the company the benefit of his knowledge until the company should be in successful operation.

Crockett was without means to find the needed $25,000; so he went to Duluth, where he enlisted Alworth, who on behalf of himself and friends engaged to find the necessary funds, Crockett himself contributing $2,000. The terms upon which Alworth found this money, except as to a further transfer of shares by Crockett, to which I shall presently refer, are contained in an agreement dated 10th May, 1894, made between the Baileys, Beatty, Gallagher and Tallyard of the first part, and Crockett of the second part, and Alworth of the third part, which, after reciting the leases (or applications for them), the expenditure by Crockett of time and money in preparatory development work, and in enlisting Alworth and his associates in the enterprise, goes on to provide for the completion of the leases, and the formation of a company to be called the Anglo-American Mining Co., Ltd. Liability, to be capitalized at the same amount divided into the same number of shares, as provided by the agreement of the 9th February, 1894, and having for its purpose the construction and operation of suitable and proper plant for the development of the property, and the dredging of the bed of the river for gold. The agreement goes on to provide for the transfer of the leases to the intended company, Crockett engaging to devote himself wholly to the procuring and equipment of suitable plant for dredging the river. Alworth agrees to pay into the treasury of the company the necessary moneys, including the first year's rental upon the leases, such moneys in the aggregate not to exceed $25,000, to be paid from time to time as required, "it being by all the parties hereto assumed and believed that the moneys herein provided for shall be sufficient," for the purposes of dredging operations. For these considerations Bailey & Co. agreed to cause to be issued and delivered to Crockett 51 per cent. of fully paid and unassessable capital stock, in full discharge for his services, etc., and Crockett agrees immediately upon receipt thereof from the company, in consideration of the moneys agreed to be furnished by Alworth, to transfer and deliver to Alworth $850,000 in par value of the stock of the corporation. The remaining 49 per cent. of the capital stock is to be issued and delivered to the Baileys & Co., as fully paid and unassessable stock, "the same to be in full consideration of all the expenditures of time, money and labor by them and in full consideration for the transfer and delivery to the company of the leases.' It is then agreed that should the $25,000 to be furnished by Alworth be insufficient for the construction of the plant, and its establishment in successful operation, then that any further moneys which might be required, should be furnished and raised without Alworth contributing thereto at all; and, so as to provide an assured means for raising such further moneys when required, the Baileys & Co. and Crockett are to deposit in escrow with a chartered bank, the Baileys a one-third part of their 49 per cent. and Crockett a one-third part of so much as remains of his 51 per cent. after deducting thereout the $850,000 to be transferred to Alworth. It is further provided that this escrow stock should be held in trust to the order of a committee to consist of Crockett, Gallagher and Alworth, and that in case it became necessary to find money in excess of Alworth's $25,000, that sufficient to meet such excess should be raised by sale of escrow stock ("to be made up by contributions pro rata from respective holdings thereof") at a price to be fixed by the committee; the owners being at liberty to save their stock from sale by contributing "cash in place thereof." It is also provided that the plant is to be deemed completed and in successful operation, when the same should be accepted by the board of directors of the company.

From the evidence it appears that the company was duly formed, but before its formation Crockett agreed to turn over to Alworth one-third of his remaining interest in the company. The consideration for so doing is stated by Alworth to have been $508.42, a payment certainly made by him to Crockett, for which the cheque was produced. Crockett, on the contrary, swears that these shares were turned over to Alworth for no valid consideration, and the suggestion is that they were turned over for and as part of a scheme to give Alworth an undue advantage over the other shareholders. Still, the fact remains that $508.42 was paid by Alworth to Crockett. Crockett does not satisfactorily account for this payment; in one place he says it was paid him for his share in money realised for some stock bought from Tallyard; but that is a manifest mistake, for the Tallyard money, some $590, was a separate payment; in another place he says the $508 cheque was for a two-third share of expenses somehow or another, but how he does not explain, due from Alworth to him. In face of such conflicting statements, I am bound to believe Alworth's account, which shows that the one-third of Crockett's stock, other than the 85,000 shares stipulated for under the agreement of 10th of May, was purchased for a cash consideration of $508.00, which, as Alworth says, was for one-third of his expenses which he (Crockett) placed at that sum. I must say that I did not quite understand at the trial what this meant, but, in reading over the correspondence, I find not only an explanation of what was meant by expenses, but a cogent, because accidental corroboration of Alworth's evidence on this point; not alluded to, so far as I remember, at the trial. I refer to Crocket's letter to Alworth, dated June 8th, 1894, being a distinct offer of the share of stock in question, at the price mentioned, which is stated to be Crockett's expense so far in securing the property. It appears also that Crockett agreed to transfer a further one-third of his shares to Wood and Heimick, in consideration, as I understand Crockett, for their introduction to Alworth, and the others who put the money in. These others have no complaint to make regarding this transfer of stock to Wood and Heimick. The company was incorporated on the 3rd July, 1894, and, before its first meeting, Wood and Heimick, by indenture dated 30th July, agreed to pool their stock, amounting in the aggregate to 127,500 shares, thus giving them absolute control of the company, and at the meeting of 30th July, Alworth, Wood and Crockett were elected directors, and, conformably to the agreement of the 10th of May, 85,000 shares were allotted to Alworth, and 42,500 to Crockett, who, pursuant to his agreement with Wood and Heimick, transferred them each 14,166 shares, and the same number to Alworth. It also appears that Alworth transferred some of his 85,000 shares to Wood and Heimick for what they had cost him. Alworth, Wood and Heimick have all along acted in concert; in fact, it appears that Wood and Heimick's shares practically belong to Alworth, and they have acted throughout as Alworth's agents.

It further appears that after the $25,000 subscribed, as to $8,500 personally by Alworth, and as to the remainder (except Crockett's $2,000) by Alworth or his friends, had been exhausted, Crockett moved and Gallagher and all parties consentep to assess the escrow stock $3,000 to pay liabilities, and afterwards again a second assessment was ordered, upon the motion moved and carried by the votes of Gallagher and Crockett. Crockett during all this time was engaged in procuring and placing in position the necessary machinery and plant for the prosecution of mining operations, drawing for the necessary moneys from time to time upon the secretary, Mr. Wood, who, in turn, was kept supplied by Alworth, who, to quote from Crockett's evidence, "was very prompt in sending his money to help along the enterprise," "and there is no suggestion that his accounts are not straightforward and clear," and; in a letter to Alworth, dated August 17th, 1894, Crockett says: "I feel as though Wood getting me acquainted with you, and the fact of your getting the capital to put this thing on its feet, ought to earn me a fortune and a very large one."

Eventually, when the plant was getting towards completion, Crockett met with a mishap in running the dredge ashore. It was a pure mishap as far as I can see, and no particular blame attributable to Crockett. He seemed, however, to blame himself, and on the 2nd January, 1895, sent in his resignation, and Alworth then undertook to complete the plant. Up to this time the most perfect confidence existed between Crockett on the one hand and Alworth and his associates on the other, but, soon after the resignation trouble developed itself between Crockett and Alworth, Gallagher and the Baileys ranging themselves on Crockett's side. Some thousands of dollars more than had been raised by the two assessments were, in Alworth's opinion, required to properly complete the plant, but Crockett contended that it could be done for $100 or $150, and he and Gallagher, as members of the escrow committee, refused to levy the necessary assessment, which refusal led to the suit to compel the carrying out of the agreement, which resulted in a decree accordingly. The present suit was then brought to remove Crockett and Gallagher from the office of trustees, and was opposed mainly on similar grounds to those set up in the counter claim presently mentioned.

On the 30th day of July at the commencement of the trial I made an order removing Crockett, but Gallagher, having intimated his willingness to concur in the assessment, was permitted to remain as trustee, and the trial was adjourned. The assessment for raising the necessary money has been levied accordingly upon the escrow stock, but matters can now proceed no further, as Gallagher refuses to concur in a sale unless ordered to do so by the court, and the further hearing of the case with the object of removing Gallagher has now been proceeded with.

In this stage of the suit Edwards has been joined as a party, and given leave to counter-claim against the plaintiff, Alworth, and against Wood and Heimick, and, as a co-plaintiff with Gallagher and Crockett, he complains—and I must admit with considerable reason—that he has been defrauded and deluded into buying shares at a comparatively high price which are now placed in competition with escrow stock, which is being sold for next to nothing. But who has so deluded him? Not Alworth, Heimick or Wood, so far as I can discern, but the very men with whom he is associated in this litigation, his co-plaintiffs, Crockett and Gallagher. Edwards purchased a portion of his shares at the first sale of escrow stock, which sale was ordered, as it will be remembered, by Gallagher and Crockett, and the remainder from T. J. Beatty. He says he made no enquiry regarding the formation of the company, but as alluring Mr. Edwards to the auction sale, a highly seductive and untruthful advertisement was published, and prospectus issued, prepared not by Mr. Alworth, but by Mr. Gallagher and one of the other members of the committee.

The advertisement was as follows:

NOTICE TO THE PUBLIC.

IMPORTANT AUCTION SALE OF MINING STOCK.

I have received instructions to offer for sale by public auction at my auction room 63 Cordova street, on

SATURDAY EVENING, THE 12TH INST.,

without reserve, a number of shares of the Fraser River Mining and Dredging Co., Limited.

This is no wild-cat scheme as it has been proved that there are immense quantities of gold in the bed of the Fraser river, which can only be secured by dredging on account of the strength of the current.

The plant, costing $40,000, has been purchased and set up ready for work, and it is of the best and most modern manufacture, and will soon be working, so that only a short time will intervene before large returns may confidently be expected from the present outlay; an opportunity like this may possibly never occur again to secure stock in this the most promising project for the securing of the precious metal so near the hand of man and which in the past has been so difficult to obtain.

S. J. EMANUELS,
Auctioneer.

Remember the time and place, 63 Cordova street, Saturday evening, 8 p.m.

In truth no such sum as $40,000 had been expended, and so far from the dredge being set up ready for work, both Mr. Gallagher and Mr. Beatty, as well as Mr. Crockett, knew it was stranded on a bar, and time and trouble must be expended in getting it to work. "The large returns which may confidently be expected" may or may not materialize; in the meantime it is an utterly undevelopad property. Gallagher and Beatty also prepared a prospectus—for which Alworth is not shown to have been in any way responsible, or even to have seen—the material portions of which, to put the matter very mildly, are perfect fiction. No prospecting of any kind has been shown to have been done by the Fraser River Mining and Dredging Company; in fact, it is notorious that the company, without anything but the bare word of Mr. Crockett when he went to Duluth and found Mr. Alworth and his friends, was formed to take over leases already granted to Gallagher and his associates, upon which even first year's rent had not been paid, yet the prospectus states "That the company, after spending several seasons prospecting the country and testing different dredging appliances, have secured from the Government a lease of 40 miles of the most suitable ground, * * * a thorough prospection of which shows that the bars will average $2 per yard." "The test of the different dredging appliances" was purely imaginary, as also was the statement that "The company has also secured timber limits enough to supply timber for their own use for many years;" the fact being that the company has not a foot of timber land belonging to it—a most mendacious statement all through. But, as remarked before, this production does not come from Mr. Alworth, but was concocted by the very men, Gallagher and Beatty, with whom Mr. Edwards is associated in this litigation. The company are not responsible for this prospectus, for they never issued it, and outside of Gallagher and Beatty, no one seems to have been aware of it, and Gallagher's evidence goes to show that after distributing some copies he suppressed the remainder. These gentlemen are now, through Edwards, who, after all, has but comparatively very small interest in this company, asking that Mr. Alworth, the man who has contributed all the money, shall be compelled to pay up for their benefit not only the $25,000 of which they have had the advantage, not contributing thereto themselves a single dollar, but shall pay up also the difference between the $25,000 and the 127,000 shares he holds at $10 per share. Really, if such a demand had not been soberly urged, it would be past conception.

I grant that if in debt, and being wound up, Alworth would, notwithstanding his having what are nominally paid-up shares, have to contribute for the debts of the concern to the extent of (if necessary) the face value of his shares: the Companies Act, 1890, section 20, is perfectly clear on this point. But that is not the case, no creditors intervene. In England under the Companies Act, 1862, it seems to be a debatable point whether the owner of shares sold at a discount can, during the life of the company, at the suit of the shareholder who has paid full value for his shares, be made to contribute the deficiency. Lord Herschell in the Ooregum Co. vs. Roper L. R., 1892, Appeal Cases, 125, was prepared to hold, had the point been urged, that he could not, and in *re* "the Pioneer of Mashonaland Syndicate," 3 Rep. 265, Mr. Justice Vaughan Williams distinctly holds that a fully paid-up shareholder has no right to assert such claims, either by action during the life of the company, or by petition upon winding-up. If such is the law under the English Joint Stock Companies Act of 1862 and 1867, a fortiori would it be the case under the British Columbia Companies Act, 1890. I can well understand that, proceeding under the Companies Acts of England, Lord Halsbury should in "*Re* Railway Time Tables Publishing Co., 12 R., 121," whilst holding himself at liberty to uphold the contrary rule should the case come before the House of Lords, hold that in the Court of Appeal, upon a winding-up shares issued at a discount must contribute. That undoubtedly is the law, as established by in *re* Almada and Tirito Co., 38 Ch. D. 415, 59 L. T., 159, and in *re* Weymouth and Channel Islands Steam Packet Co.,, (1891) 1 Ch. 66, 63 L. T., 686, and I should not be surprised to find that when the point comes before the House of Lords Lord Herschell's strong dictum the other way is overruled; but that is because of, and the English cases proceed upon, sections in the Companies Act, 1862, which are absent from the British Columbia Companies Act. In the English Act, under "Liability of Members," the measure of such liability is an amount sufficient to satisfy all claims of creditors; to pay all expenses of liquidation, and to adjust the claims of members *inter se*, and section 25 of the English Act of 1862 specifies as part of the information to be entered on the register of members the amount "paid, or agreed to be considered as paid," "on the shares of each member." Here we have no corresponding legislation to this, its operation; so far as liability of the shareholder to contribute seems limited to the claims of creditors. Sections 6 and 20 of the Companies Act, 1890, are as follows:

6. "No shareholder in any such company shall be individually liable for the debts or liabilities of the company; but the liability of each shareholder shall be limited to the calls and assessments to be legally levied upon the shares held by him."

20. (1) "Each shareholder, until the whole amount of his stock has been paid up, shall be individually iiable to the creditors of the company, to an amount equal to that not paid up thereon, but shall not be liable to an action therefor by any creditor before an execution against the company has been returned unsatisfied in whole or in part; and the amount due on such execution shall, subject to the provisions of the next section, be the amount recoverable with costs against such shareholders."

(2) "Any shareholder may plead by way of defence, in whole or in part, any set-off which he could set up against the company, except a claim for unpaid dividends, or a salary, or allowance as a trustee."

Whatever view may hereafter be taken nnder the English acts of Lord Herschell's remarks, they appear to be unassailable when applied to the British Columbia Act, and they directly apply to this case: "But the question before Your Lordships does not arise in the case of a winding-up. The interest of the creditor is not in issue. The action is brought by a shareholder avowedly for the purpose of benefitting the holders of the ordinary shares at the expense of those who are possessed of the preference shares which were taken on the express condition that their holders should not be required to pay more than £5 per share. To accede simpliciter to the prayer of the plaintiff, would, as it seems to me, be to sanction a violation by the company of a solemn agreement entered into between them, and those who took the shares. I should have thought it was wrong to do this, except in so far as the contract provides for that which has been otherwise provided for by the legislature. In so far as the obligations arising under the contract do not involve a contravention of any enactment of the legislature, I see no reason why they should not have effect given to them. * * Except when the legislature has expressly, or by implication, forbidden any act to be done by a company, their rights must be governed by the ordinary principles of law, and they are free to make, as between themselves and their shareholders, such contracts as they please." (See also Canada Law Journal, February, 1894, p. 35.)

It appears to me, although the point was not urged in the argument of this case, that there is a wide distinction between the English companies' acts and our own. It was strongly urged by Mr. Bodwell that the acceptance by Alworth and by Heimick and Wood of the two-thirds of Crockett's stock, and the transfer by Alworth to Heimick and Wood of part of his 85,000 shares at bedrock prices must be taken as bribes accepted by directors, for which, upon principles laid down in "Re Nant.-Y.-Blo. case," L. R. 12, Ch. D., 738, and "Re G. Newman & Co., 12 R. 148," they must account to the company, and, as showing that Alworth was taking something which he knew to be morally wrong, reference was made to his ietter to Crockett, in which he asks Crockett to write him a letter (which Crockett never wrote and does not produce), in form of a draft letter enclosed in Alworth's, denying that he, Alworth, had anything on "the side in the company," "as some persons seemed to think that he, Alworth, had some side agreement." I find myself unable to place any such unfavourable construction on Alworth's letter. I think that in asking a denial of any "side agreement" he had in mind only his position, and, honestly, asked a denial of that which could with truth be denied. It is significant that Crockett, whilst endeavoring to give a dishonest impression to Alworth's letter, does not produce the letter which Alworth asked him to write. I observe no indications of anything fraudulent or wrong in the transfers as between Crockett, Alworth, Heimick and Wood, and, in the absence of fraudulent intent, such transactions are not open to impeachment. (Lands Allottment Co. vs. Broad, 13 R., 101.)

The ground of Gallagher's defence and of Edwards' counter claim, is a charge of fraud against Alworth, which, in my opinion, utterly fails. If it could be shown, as claimed by the pleadings that the actions of Alworth, Wood and Heimick "are part and parcel of a fraudulent and collusive scheme and conspiracy between them to obtain control of the company by any means, and to practically close out all the Vancouver shareholders, and that Alworth is the prime mover therein, and Wood and Heimick are merely active tools employed by him to carry out such illegal and fraudulent schemes and purposes," there would be no difficulty in bringing justice home to Alworth. I think Edwards is entitled to some consideration, but not against the company, who had issued their shares before his purchase. He was, I think, too sanguine in buying shares without making enquiry as to the constitution of the company, but, at the same time, I think the company was blameworthy in not taking care to disclose its true position before the escrow shares were offered for sale; or, indeed, before it came into the power of Beatty, Gallagher and other shareholders to dispose of stock. On this ground, in dismissing Edwards' counter claim, which I do, I shall dismiss it without costs. (See British Seamless Co., L. R. 17 Ch. D., p. 475.)

Crockett and Gallagher are, I think, mainly responsible for all the trouble. The former was guilty of what appears to me from one of his letters of a deliberate suggestion to load the mine, and so practice a huge deception upon the public. Gallagher, besides being associated with bad company, was responsible for a fraudulent prospectus, and a false advertisement. Crockett has already been removed from the trusteeship. The order will be to remove Gallagher also, and that the plaintiffs, by original action, recover their costs of suit against Gallagher and Crockett.

METALLURGICAL NOTES.

Wet Copper Assay.—Mr. R. S. Dulin, in the Journal of the American Chemical Society, advocates the precipitation of copper by strips of aluminium *re* dissolving the copper in nitric acid, adding excess of ammonia and titrating with standard cyanide of potassium solution, care being taken that the same amount of nitric acid and ammonia are used in both the check and the assay. We have always found that when care is taken to eliminate foreign bodies and the check is made analogous in every way to the assay, that the cyanide method gives results very closely approximate to both the iodide and electric methods.

Mr. Albert Ladd Colby read a paper before the autumn meeting of the Lehigh Valley branch of the American Chemical Society on Rapid Methods of Iron and Steel Analysis. He stated that 2,444 analyses were made in a single week in the laboratory of the Bethlehem Iron Co. At the close of the meeting a souvenir was given to each member; it consisted in one of the armor-plate washers manufactured by the Bethlehem Iron Co. on which was engraved, "Accurately analyzed for carbon in 12 minutes; manganese in 10 minutes, phosphorous and silicon in 30 minutes." The name of the member to whom it was presented and the date and place of meeting was also stamped on the washer.

After the decision of the English Court of appeals (with reference to the MacArthur-Forrest patent for extracting gold from its ores by cyanide of potassium) that the patent could be upheld if the specification and second claim alone were considered, but that the first claim was contradictory and therefore made the patent invalid, the Cassels Gold Extraction Co., who own the patent, appealed to the Controller-General of Patents for leave to amend the patent, and the same was granted them. The amended patent has recently been published. The body of the specification remains unaltered. In the first claim the word dilute (as applied to the strength of the cyanide solution) has been omitted, and the second claim is really a disclaim, for it reads, "We declare that we do not claim generally the use of solutions of any strength."

A new book entitled "Economic Mining," by C. G. Waraford Lock, has just been published by E. &. F. N. Spon, London. The book is divided into three parts, the first part treating of mining and metallurgical operations generally, prospecting, power drilling, blasting, shaft and well-sinking, ventilating, lighting, winning, hauling, hoisting, concentrating and reducing. The second part treats of non-metalliferous minerals and the third part of metalliferous minerals. By omitting the too customary historic sketch, the author gained space for matter of economic if not of scientific value.

Mr. M. C. Klement has succeeded in making dolomite from carbonate of lime; previous experimeaters have always worked on calcite and failed. Mr. Klement argued that as dolomite was often found in coral reefs, and Sorby has shown that the carbonate of lime in coral reefs probably existed as argonite, he therefore concluded to experiment on aragonite. From a large series of experiments he finds (1) that a solution of magnesium sulphate in the presence of chloride of sodium at a temperature of, or above 60° C. decomposes aragonite with formations of magnesium carbonate; (2) that this action increased with the rise of temperature, and with the concentration of the solntion, and is greatly diminished by the absence of sodium chloride; (3) that recent coral is attacked by magnesinm sulphate in the same way as aragonite; (4) that the lagoons of modern coral reefs afford all the conditions of temperature saturation, etc., necessary for the production of carbonate of magnesia in the manner of his experiments.

The *Zeitschrift fur Amorgamsche Chemic*, gives a very complete account of the synthesis of metallic ores by crystalization from solution in the appropriate molten metal by Fredrich Roessler. The work includes the production of crystalline sulphides and selenides of such metals as lead, bismuth and silver, or arsenides, antimonides and bismuthides of platinum, paladium and gold. Thus, for instance, silver bismuth sulphide was obtained by adding 2 grammes of silver sulphide to 20 grammes of molten bismuth, the product was subjected to the action of nitric acid (sp. gr. (1.1) and there remained dark crystals intermixed with silver white crystals, the latter consisted of a bismuth silver alloy and finally dissolved in the acid. The dark crystals on dying, possessed a silver-blue lustre forming pretty groups of octahedra attached in rows and had the composition $Ag\ Bi\ S_2$, and Ag_2S; $Ba_2\ S_3$.

Canadian Companies

Otter Flat Gold and Platinum Mining Co. Ltd., has been registered at Victoria, B.C., to operate mines in the Province of British Columbia. Authorized capital, $200,000, in shares of $5. Directors, Samuel K. Twigge, Benjamin J. Cornish, and Arthur B. Diplock. Head office, Vancouver, B.C.

Evening Star Mining Co. Ltd., registered under the Foreign Companies Act, statutes of British Columbia, 5th October, 1895, with an authorized capital of $1,000,000 and headquarters at Spokane, Wash.

Gold Hill Mining Company Ltd., registered 14th October, 1895, with an authorized capital of $500,000, and headquarters at Spokane, Wash. To operate in British Columbia.

Arganaut Gold Mining Co. of Kootenay, Ltd., is applying for incorporation in British Columbia, with an authorized capital of $5000,000, to take over and acquire in any lawful manner, mining leases or mining claims, or any other mining property, in any part of the Province of British Columbia, and in particular to acquire from Frederick Colleton Innes, two (2) certain mineral claims situate in the Trail Division of Kootenay District, known as the Eleanor mineral claim, and the Londonderry mineral claim, as recorded in the Mining Recorder s office at Rossland, and to pay for the same either in cash or fully paid up stock of the company, or the bonds, debentures, shares, stock and securities of this or any other company or corporation. Head office, Vancouver, B.C. Directors, A. Graham Ferguson, S. O. Richards and John G. Woods.

Virginia Gold Mining Co., Ltd., registered 26th October, 1885. Authorized Capital, $500,000. Head office: Spokano. To operate in British Columuia.

Richmond Developing and Mining Company, Ltd., has been incorporated to adopt and carry into effect with or without modification, an agreement dated the 29th October, 1895, between Alexander McLeod, Charles Barney, and J. T. Errington, and to carry on mining in British Columbia. Authorized capital $120,000, in shares of $10.00 each. Head office: Vancouver, B.C. Directors: Alexander McLeod, Charles Barney and John T. Errington.

Dominion Developing and Mining Company, Ltd., is seeking incorporation to carry on the business of mining in British Columbia with an authorized capital of $500,000. Head office: Vancouver, B.C. Directors: George Lawson Milne, Victoria, B.C.; John McQuinlan, John J. Banfield, Jonathan Miller, and John P. Carroll, all of the city of Vancouver, B.C.

Silverine Gold Mining Co., Ltd., registered 30th October, 1895. Authorized capital, $500,000. Head office: Spokane. To operate mines in British Columbia.

Chandos Mining Co., Ltd. Application for incorporation under Ontario statutes. Authorized capital, $199,000, in shares of $100. Head office: Toronto. Directors: J. A. Hanway, New York; Jas. Robinson, Montreal; R. H. Green, Toronto; J. G. Young, Toronto; and James Pearson, Toronto.

Krupp's Mining Machinery.

The ore concentration plant which was shown erected and in work by the firm of Fried. Krupp Grusonwerk of Magdeburg-Buckan, Germany, at the Mining Exhibition in Santiago, has been bought by the Chilian Government for the school of mines there.

Fl Ferrocarril reports that the ore concentrating machinery of the above named firm obtained special award and two first prizes at the Santiago exhibition.

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No.	Price.	Horse Power.
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10	7 00	8 to 16
15	10 50	16 to 40
20	15 00	40 to 72
25	22 50	72 to 120
35	30 00	120 to 220
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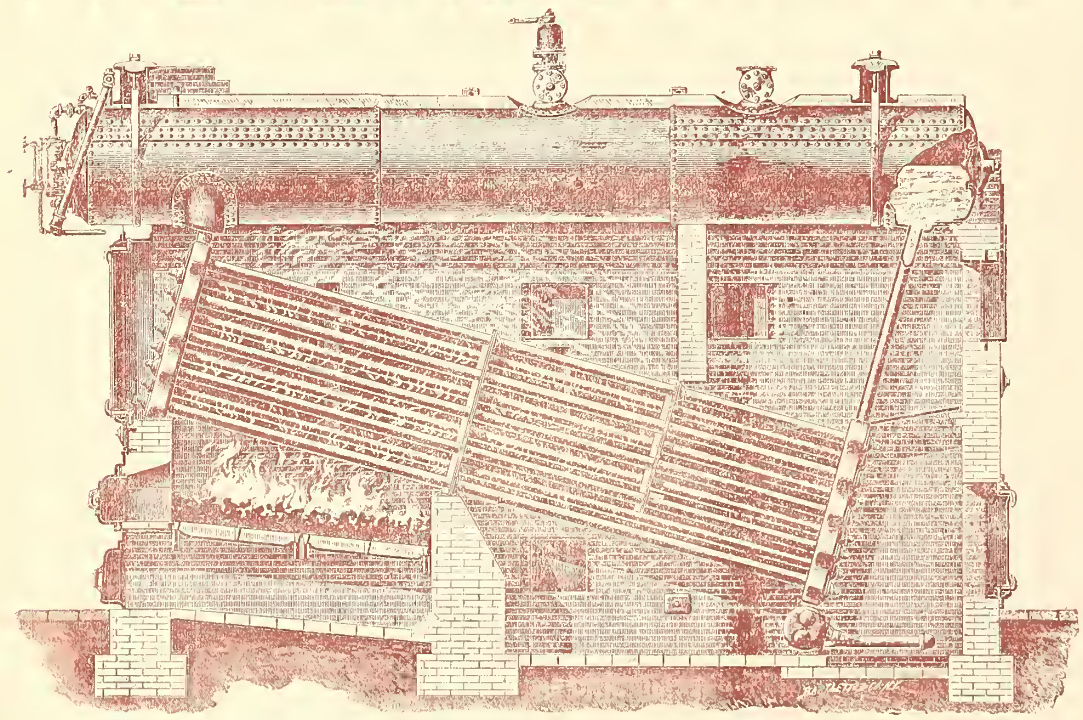

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GOLD AND SILVER.

Under the provisions of chap. 1, Acts of 1892, of Mines and Minerals, Licenses are issued for prospecting Gold and Silver for a term of twelve months. Mines of Gold and Silver are laid off in areas of 150 by 250 feet, any number of which up to one hundred can be included in one License, provided that the length of the block does not exceed twice its width. The cost is 50 cents per area. Leases of any number of areas are granted for a term of 40 years at $2.00 per area. These leases are forfeitable if not worked, but advantage can be taken of a recent Act by which on payment of 50 cents annually for each area contained in the lease it becomes non-forfeitable if the labor be not performed.

Licenses are issued to owners of quartz crushing mills who are required to pay Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at $19 an ounce, and on smelted gold valued at $18 an ounce.

Applications for Licenses or Leases are receivable at the office of the Commissioner of Public Works and Mines each week day from 10 a.m. to 4 p.m., except Saturday, when the hours are from 10 to 1. Licenses are issued in the order of application according to priority. If a person discovers Gold in any part of the Province, he may stake out the boundaries of the areas he desires to obtain, and this gives him one week and twenty-four hours for every 15 miles from Halifax in which to make application at the Department for his ground.

MINES OTHER THAN GOLD AND SILVER.

Licenses to search for eighteen months are issued, at a cost of thirty dollars, for minerals other than Gold and Silver, out of which areas can be selected for mining under lease. These leases are for four renewable terms of twenty years each. The cost for the first year is fifty dollars, and an annual rental of thirty dollars secures each lease from liability to forfeiture for non-working.

All rentals are refunded if afterwards the areas are worked and pay royalties. All titles, transfers, etc., of minerals are registered by the Mines Department for a nominal fee, and provision is made for lessees and licensees whereby they can acquire promptly either by arrangement with the owner or by arbitration all land required for their mining works.

The Government as a security for the payment of royalties, makes the royalties first lien on the plant and fixtures of the mine.

The unusually generous conditions under which the Government of Nova Scotia grants its minerals have introduced many outside capitalists, who have always stated that the Mining laws of the Province were the best they had had experience of.

The royalties on the remaining minerals are: Copper, four cents on every unit; Lead, two cents upon every unit; Iron, five cents on every ton; Tin and Precious Stones; five per cent.; Coal, 10 cents on every ton sold.

The Gold district of the Province extends along its entire Atlantic coast, and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the Counties of Cumberland, Colchester, Pictou and Antigonish, and at numerous points in the Island of Cape Breton. The ores of Iron, Copper, etc., are met at numerous points, and are being rapidly secured by miners and investors.

Copies of the Mining Law and any information can be had on application to

THE HON. C. E. CHURCH,

Commissioner Public Works and Mines,

HALIFAX, NOVA SCOTIA.

The Canadian Mining Review

Established 1882

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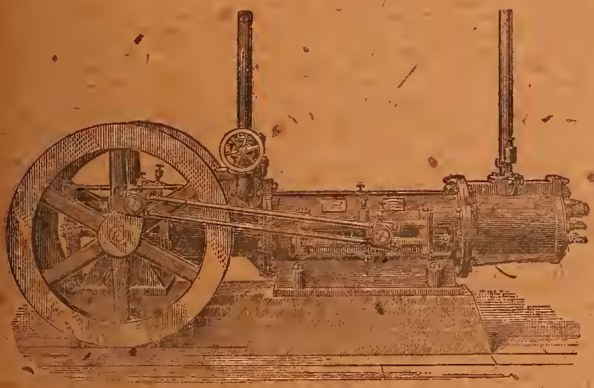

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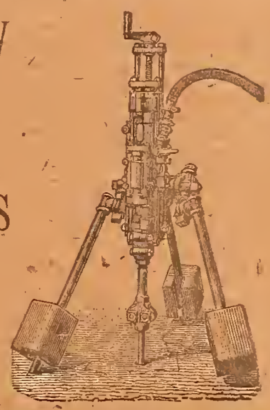

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MINING LAWS OF ONTARIO.

ANY person may explore Crown Lands for minerals.

Mining lands may be taken up as surveyed locations or staked claims.

Locations range from 40 to 320 acres.

Claims range from 10 to 20 acres on vein or lode.

Locations may be acquired in fee or under leasehold.

Price of locations north of French River, $2 to $3 per acre, and south of it, $2 to $1.50, according to distance from railway.

Rent of locations first year 60c. to $1 per acre, and subsequent years 15c. to 25c. per acre.

Rent of claims, $1 per acre each year.

Claims must be worked continuously.

Royalty on ores specified in the Act, 2 per cent. of value at pit's mouth less cost of labor and explosives.

Royalty not charged until seven years from date of patent or lease, nor (as provided in s. 4 (3) of the Mines' Act, 1892), until fifteen years in the case of an original discovery of ore or mineral.

Original discoverer of ore or mineral on claim entitled to stake out a second claim.

Crown Lands sold under provisions of mining laws in force prior to 4th May, 1891, exempt from royalty.

Copies of the Mines Act, 1892, Amendment Act, 1894, may be had on application to

ARCHIBALD BLUE,
Director Bureau of Mines

TORONTO, May 25th, 1894.

CONDITIONS
OF
Obtaining Government Drill to Explore Mines or Mineral Lands.

Owners or lessees of mines or mineral lands in Ontario may procure the use of a Government Diamond Drill, subject to the provisions of the Rules and Regulations relating thereto, upon giving a bond for payment to the Treasurer of the Province, of costs and charges for (1) freight to location, (2) working expenses of drill, including labor, fuel and water, (3) loss or breakage of bits, core lifters and core shells, (4) wear or loss of diamonds, (5) other repairs of breakages and wear and tear of machinery at a rate per month to be estimated, and (6) an additional charge of $50 per month after the mine or land has been shown, through use of the drill, to be a valuable mineral property.

Of the aggregate of costs and charges above enumerated, excepting the sixth item, forty per cent. will be borne by the Bureau of Mines in 1894, thirty-five per cent. in 1895, thirty per cent. in 1896, and twenty-five per cent. in each year thereafter until the end of 1900. All accounts payable monthly.

For Rules and Regulations *in extenso* governing the use by companies and mine owners of Diamond Drills, or other information referring to their employment, application may be made to ARCHIBALD BLUE, Director of the Bureau of Mines, Toronto.

A. S. HARDY,
Commissioner of Crown Lands.

Toronto, October 17, 1894.

The Canadian Mining Review
Established 1882

Official Organ of The Mining Society of Nova Scotia; The General Mining Association of the Province of Quebec; The Asbestos Club; and the Representative Exponent of the Mineral Industries of Canada.

B. T. A. BELL, Editor. Published Monthly. OFFICES: Slater Building, Ottawa.

VOL. XIV., No 12 DECEMBER, 1895. VOL. XIV., No. 12

Mining Legislation in Nova Scotia.

Elsewhere in this issue we publish the report of a committee of the Mining Society of Nova Scotia on the broad subjects of existing and proposed mining legislation, and on the general policy of a Government towards the industry of mining. This report will attract attention not only from the importance of the subjects discussed but because, sooner or later, a similar discussion of like subjects will be provoked in every Province of the Dominion in which mining plays an important part.

The report bears on its face evidence of hasty preparation, many of the subjects being treated in an inadequate way, and the Mining Society has done well in referring the whole matter back to an enlarged committee for revision; nevertheless it is worth while to notice, both favorably and adversely, some of the salient points

It must be remembered that the suggestions and criticisms contained in the report are not only the gleanings from members of the Society, but embody also the opinions of persons interested in mining who are not members of the Mining Society, but to whom circulars were sent.

Naturally, the first and most important subject is the question of title, and its tenure; for upon security in this respect must rest all claim for capital. It is noteworthy that whereas ten years ago the lease of 21 years duration was rarely criticised in Nova Scotia, there is now a very decided and unanimous opinion that if a leasehold title *only* can be given, that lease should be for very long periods, as for one hundred years; and this too obtains in spite of the fact that six years ago the Act increased the length of a gold lease from 21 to 40 years. The suggestion offered in the report of an indefeasible lease, or lease in perpetuity, under proper and suitable restrictions, was advocated by the old Gold Miners' Association in 1889, and, we believe, was presented to the Government with other recommendations, some of which were adopted.

Such a lease is the inevitable and legitimate conclusion of the best thought on the subject, strengthened by the experience of the attempts which have been made to enlist foreign capital in the mining industry of Nova Scotia. No one is anxious to invest money in any mining enterprise, the title to which is in the nature of a lease surrounded by restrictions and forfeiture penalties, which imperil the title to all personal property acquired, and which an accidental oversight may any day throw into the courts for never-ending litigation

We suggest to the committee which is to revise the present report, the careful and thorough study of the new Spanish code on the points of title, tenure, forfeiture and exemption, with the expressed opinion that no better system of leasehold title has ever yet been formulated.

The practice of granting leases for precious metals and leases for base metals over the same territory comes up in the committee's report, *e.g.*, a lease of one square mile for copper is granted to one lessee, and to another lessee a portion of the same square mile is granted for gold and silver. The manifest opportunities for disagreement, litigation and so on, need no comment. But we do not think the remedy suggested in the report at all meets the difficulty. To undertake to impose a metallurgical distinction of "free milling" or "refractory" upon ores that are just discovered and not worked (the usual condition of property at time of acquirement from the Government) is piling Ossa upon Pelion in a vain attempt to reach wisdom. The governing principle of laws for the acquisition of undeveloped mineral lands is simplicity and clearness of the conditions imposed, which the suggestion made does not meet. Another difficulty that is apparent to any experienced mining manager is the frequent change in the character of ore from free milling to refractory, and occasionally *vice versa*. A title to all the mineral contained within a given area appears to us the only solution of this difficulty, or, at any rate, a clear prior right to obtain title to all such mineral, with an owner's privilege of sub-leasing, and with the owner's responsibility for all Government dues and royalties.

And, speaking of royalties, we note the emphatic demand of the report for their entire abolition. The report is obscure in this respect, not specifying whether coal, as well as gold, royalties are meant. If the affirmative is true the report is deficient in failing to mention any equivalent source of revenue for the Government. It would appear, however, that only gold royalties are meant, as the report goes on to suggest a royalty on *net values* of gold produced. We must say that we think the member suggesting a fixed net value of $4.50 per oz. of melted gold is rather giving his case away, and would be inclined to go into the question of the average cost of producing an ounce of gold in Nova Scotia were it not for two reasons; the first of which is lack of space in this already very large issue of the REVIEW, and secondly the utter impracticability of any Government system of royalties upon *net values*.

The Quebec Act has a clause to the effect that royalties may be imposed upon "the value at the mine, after deducting the costs of the extracting," but the clause has never been enforced, it being recognized as impossible of application, and is today a dead letter.

So far as the Government is concerned a royalty upon net values would be a jump from the frying-pan into the fire, for the opportunities such a law would afford for fancy book-keeping, and the fearful and wonderful costs that would be revealed would shut out foreign capital most effectually and for ever. The REVIEW has long been of the opinion that the royalty question in Nova Scotia can safely be left until titles and more important reforms are effected.

The difficulty of dealing with the subject of stolen gold is only fully appreciated when one has endeavored to prosecute and convict workmen who have been found with gold in their possession to which they had no right and by which they could not have honestly come. The Provincial and Dominion Statutes have been pleaded in the courts over and over again, but the offender goes free. It is on account of this difficulty that the managers of gold mines of Nova Scotia are so anxious to have remedial legislation.

The establishment of a Provincial office where all smelted gold must be presented, weighed, stamped and its source noted before it can be sold or offered for sale is a suggestion made by one of the oldest and most experienced men in gold mining in Nova Scotia, and is worthy of serious consideration. The legal point of whether legislation creating such an office should be Dominion rather than Provincial, since it might be held to belong to banking in some form, is one the committee should have given an opinion upon, as two able lawyers were members of that committee. We suggest that branches of the Dominion Savings Bank should be available for such a purpose, in collaboration with the Provincial authorities. But we are not sanguine that such a scheme will prevent pilfering, nor illegal sales of gold, and it is certain that no machinery is so effectual as the changing-house system which has had the experience of forty years in Australia and the western United States; individual efforts must continue to be made, if backed by statutory enactments so much the better.

We had hoped that the oft-mooted bonus for deep mining had taken a more serious shape than the old story of so much per foot for each foot beyond a prescribed depth. Formerly when this question was raised the bonus was for each foot below 500; now that individual, or rather unaided, efforts have reached and exceeded that depth in several districts, the limit has been increased to 800 feet, and it seems to us that this experience of the last six or seven years is a sufficient argument against Government aid taking the form of a bonus per foot. It is a matter of personal knowledge to us that the Government of Nova Scotia is anxious to encourage deep mining and very willing to give financial help whenever the representatives of the gold mining industry unite upon a measure for aid which is equitable and which shall be applicable to each and every district. Furthermore it is expected that such aid as may be given shall benefit the industry as a *whole*, rather than any single district or company.

Many of the minor difficulties mentioned in the report would vanish, or find their remedies, in an adequate system of inspection. There have frequently appeared in this paper paragraphs respecting the inefficient inspection of Nova Scotia gold mines, but the root of this difficulty is in a mistaken economy which compels the efficient chief inspector to also fill the onerous position of deputy commissioner. This does not excuse, however, the bad appointments which have been made of deputies for the gold fields, who are notoriously unpopular with the managers, and who are not fitted by training or experience for such a responsible position.

The various criticisms upon the "Mines Regulation Act" are from competent practical men of large experience in the coal fields, and their suggestions deserve the most serious consideration.

As much, however, cannot be said for the suggestion regarding the establishment of a school for the training of mining engineers in Nova Scotia. The topic is too broad for a thorough discussion within the limits of this article, but we wish to endeavor to disabuse the minds of the committee that any education "easily and cheaply obtained" is worth the having.

More than any other profession, engineering or otherwise, that of the mining engineer is the hardest to thoroughly master, and embraces a wider range of subjects than any other. Not alone does it require civil, mechanical and hydraulic engineering training, but also that of the chemist, geologist and man of business.

The report is full of thought-provoking matter, and it is an important contribution to the records of the Society. The committee to whom it has been referred, have an opportunity rarely afforded, of producing a second report which shall thoroughly represent Nova Scotia opinion on Nova Scotia mining, and as such be sought for as a reference pamphlet for some time to come.

The Canadian Mining Institute is now *un fait accompli*. A meeting of the delegates from the various societies in the federation will probably be held at Montreal during the sessions of the General Mining Association to consider a programme for the year.

The Cape Breton Coal Trade.

The season of 1895 has not been a particularly bright one in Cape Breton and will not be looked back upon with any very lively feelings of satisfaction either by those who have money invested in its coal fields or by the men who work at and around the mines. For the miners it has been a year of somewhat intermittent work, which, in many cases must have left them with but scant means wherewith to face the rigors of the coming winter. The General Mining Association must be excepted in making these remarks. Although their shipments are a little short of last year's total, the year has been a good one, both for the company and their workmen. Beyond the lengthening of their shipping wharf, which was practically rebuilt last spring, the acquisition of more rolling stock, and the introduction of one or two coal-cutting machines, there has been no noteworthy departure in the conservative management of this company, but the excellent quality and widespread popularity of the "Old Sydney" coal have stood them in good stead once more, and brought them through a slack season with better proportionate results than can be claimed by their powerful neighbors. With congratulations to Mr. Brown and his staff upon the excellent results of their season's work, we pass to a short notice of the Dominion Coal Company's record.

Every one knows, of course, that periods of depression, of more or less severity, occur with unfailing regularity, in the coal t ade as i.1 most other lines of business, and have to be borne with equanimity like other inevitable evils that mankind is heir to. It sometimes happens that the business of a particular district is destroyed or permanently injured by competition from fresh sources more highly favored either in the cost or quality of their production, or both, but no blow of this nature has fallen from any quarter to affect the position of Cape Breton coal. In the markets that it has held for some years, at any rate, its position is as sound as it ever was, and we may therefore hope that the depression of 1895 once past, the outlook will once more brighten and the old cheerfulness be restored. The present season opened inauspiciously in every way. Stocks of coal remaining on hand in the spring at many of the large consuming points were larger than usual, while railway and manufacturing interests in the Dominion were so depressed that quantities contracted for, to be delivered over the shipping season, were cut down to as fine a point as possible. The feeling of uncertainty preceding a general election (which, at the time contracts were made, was believed to be imminent) no doubt helped to make consumers more cautious than usual in buying; and though this cause of anxiety passed away, trade throughout Canada remained quiet to the extent of dullness during the year. This state of affairs was not helped out by any opportune strike in the United States, during which a nice round quantity might have been shipped to American ports, as had been the case 12 months back, when the chance was not nearly as welcome as it would have been last spring. The abnormally low price of coal in the States throughout the year has indeed made it impossible to ship coal to that country with much better results than getting back a new dollar for an old one. Thus it comes about that the returns from Cape Breton will show a falling off of something like 150,000 tons as compared with last year, and for this shortage the Dominion Coal Co. will be responsible for about 140,000 tons. On the other hand, although the production has fallen off, prices have been maintained at the old level. What a difference in this respect and what a scramble there would have been in the old days when each colliery was under separate ownership!

One noticeable and satisfactory feature of the season's work has been the manner in which the facilities for rapid handling of the coal have been utilized, resulting in a great saving of time, both in loading and discharging, over previous years. Quite a large saving of money must have been effected in this way as a set-off to disappointments in other directions. It is true that the unprecedented lowering of the river at and above Montreal, caused by the long drought, was a serious drawback, necessitating as it did the shutting out of a large proportion of cargo each trip for a couple of months from the two "Turret" steamers that had been specially constructed to pass through the Lachine canal. This, notwithstanding the cost of freighting coal to Montreal, must have shown up well as compared with previous years. It may be mentioned that the company have half-a-dozen of these "Turret" steamers chartered for a period of five years.

The system of loading by the Ludlow tower with buckets has been thoroughly tested on the International pier, and it has been conclusively proved that coal shipped in this way turns out far better in appearance than coal shipped by means of the old-fashioned drops. To obviate the expenditure of a large sum in acquiring more buckets and flat cars on which to carry them, the company's engineers have perfected a plan whereby the ordinary hoppers are discharged into a pocket underneath the wharf. From this pocket the coal is dropped easily into a bucket which is hoisted by the tower and lowered into the hold of the vessel alongside the wharf. One bucket does the whole business, and the time saved on the original process of coupling and uncoupling each bucket and swinging it back when empty to its place on the flat car, is very considerable, while the breakage to the coal is little, if any, greater. Usually a steamer is about half loaded by this method and then finished from the shutes. It is said to be the intention of the company to erect another tower on the wharf, and the practice of shipping from the drops will in this case be altogether abandoned. About 450,000 tons will have been shipped at this wharf by the end of the year, or about three-fifths of the whole output of the company's nine collieries. A night shift has been worked during the greater part of the season, and the wharf and approaches are brilliantly illuminated at night by the arc electric light furnished from the company's own plant. The new wharf at Louisburg is considerably higher than the International, and much narrower. The method of shipping there is by shutes altogether. The capital expenditure on construction and improvements has again been large. In addition to the new wharf in Louisburg harbor mentioned above, the railway to that port has been completed and equipped in first class style. A great deal has also been done in developing and equipping the collieries, particularly at "Dominion" and the "Hub," as will be seen by reference to the illustrations given elsewhere in our columns. With the erection of a commodious and well-furnished machine shop at Glace Bay, the plan of centralizing the works at that point may be said to have been finally completed. The mines are now well provided with improved facilities for cutting, hoisting and screening coal, the railway department is in first class working order, well stocked with new and powerful locomotives and hoppers to a capacity of some 8,000 tons, and the two new piers at Sydney and Louisburg are in a position to ship all the coal that the rolling-stock can give them. The company should therefore be able to cry a halt in their lavish expenditure for a while. They are now ready to reap the benefits of their enterprise, from larger outputs and cheaper production and shipments f.o.b. The opportunity has not been afforded them this year, but they are quite prepared for it when it comes, and we hope that next year they will have the chance of doing a greatly increased business and thoroughly testing the value of all their improvements.

By the centreing of shipments at the two terminal piers, Sydney and Louisburg, the smaller out-ports of Port Morien and Glace Bay, at which large shipments were made up to the present year, have naturally suffered, and, quite as naturally, people owning property and doing business at these places have not been slow to air their grievances and to complain bitterly of the company's policy. The directors, of course, shape their policy according to business principles, undeterred by sentiment, but it is difficult to persuade a man to see the logical beauty of this when he sees his business dwindled to a shadow of its former state. Port Morien has suffered most severely in this respect. Not only has the quantity of coal shipped there fallen to below 30,000 tons, but the output from the Gowrie mine has fallen off in nearly the same proportion, only a few thousand tons of this coal having been shipped at the terminal piers. The coal for some reason has lost the popularity it enjoyed in the days when the Archibalds worked the mine, and consumers have preferred coals from the company's other mines at the same price. A new manager, with a record of much good and effective work accomplished at "Bridgeport" and "Dominion," has recently been placed there, and with good clean coal coming from the "Gowrie" again, we may hope for a return to something like the old times. As a shipping port, however, Port Morien may be said to be practically dead, and we presume that Glace Bay is *in extremis*, or approaching that state. Only a few of the smaller steamers were loaded there this year, and the shipments from the Glace Bay and Caledonia piers fell away to a third of the quantity shipped last year. As a set-off in some measure to the loss of shipping, the inhabitants of Glace Bay can count the centreing of the company's offices and works in their midst and also the opening up of the "Hub" mine. They do not seem to look upon these as a *quid pro quo*, but are kicking vigorously and loudly lamenting the "good old days" To judge from certain articles and letters in the local press, one might imagine that the resident manager, Mr. David McKeen, M.P., himself ruthlessly dictates these changes, while the real truth is, we believe, that but for his efforts in opposition, the lopping off and shutting up would have been far more sensational and much less gradual than has actually been the case. And this reminds us that a rumor is now and again set afloat to the effect that the Dominion Coal Co., its properties and franchises, are destined ere long to drop into the maw of Pennsylvania coal barons. For ourselves we place no sort of credence in these reports, but the question is one that, in a somewhat different aspect, creates a mild panic among the company's workmen in Cape Breton whenever the future of the company comes up for discussion. Mr. McKeen has recently purchased a residential estate in Halifax, and it is known and regretted that his health has been uncertain for some time past. Hence the impression that has gone abroad that his resignation from the cares of his responsible post may be looked for at no distant date. The horny-handed sons of toil are vexing their souls with conjectures as to who his successor will be. Will it be another Canadian, accustomed to and in sympathy with Cape Breton miners and their little ways, or will it, they ask, be a smart, up-to-date American from Pennsylvania, who will want to work Sundays as well as week-days, a "hustling" slave-driver from the regions where Poles, Hungarians and Italians, Jews, Turks and infidels are employed? As a Canadian paper, writing for Canadians, we hope, in the first place, that Mr. McKeen may not feel called upon to resign for some years to come, and, secondly, that when he does step down, another Canadian may be found to succeed him. Mr. Whitney and his associates have, we believe, so far treated their employees in Cape Breton with all possible kindness, and they can be trusted, we feel sure, to deal considerately with the natural ingrained preferences and prejudices of the large body of men who came into their employ with the properties they acquired three years ago.

To resume at the point where we digressed, Port Morien and Glace Bay are not the only places with grievances against the company. Sydney, the shire town, has also its tale of woe. Disappointed in its expectations that the head offices and shops would be located within its borders, it now finds that the Reserve wharf, which has been used during the year as an auxiliary to the International, is closed down and likely to remain permanently idle. This is a blow to the town, and some of the citizens talk heroically of bridging the area of the harbor known as Muggah's creek, and thus bringing the International pier within easy distance of their stores. We should like to see the citizens of Sydney unite for once in carrying through this enterprise, but we fear the millenium is a long way off yet.

The Victoria wharf has shared with the Reserve most of the bunkering business and the loading of sailing vessels, and inasmuch as the Victoria colliery is the only one which is not connected with the Sydney and Louisburg Railway, this pier seems to have a chance of remaining in operation for some time to come—at any rate, until facilities are provided at the International for bunkering steamers and loading sailing craft, without interfering with the loading of the large cargo boats.

The Dominion Coal Co. have during the past 12 months received rather more than their customary share of criticism and abuse at the hands of the local press, but, curiously enough, political parties have changed sides. It is now the Liberal organ that mercilessly belabors the outcome of its leader, Mr. Fielding's legislation, while the Conservative press, so unkind in its remarks at the outset, now magnanimously defends the management from the grave charges brought against it. The *Island Reporter* smites its bosom and protests to heaven against "bulldozing tyranny," "iron-heeled monopoly," "soul-less corporation," &c., and all, forsooth, because Mr. David McKeen is again the nominee of the Conservative party to contest the county at the next general election! In its attempts to bring him into disrepute, the *Reporter* has been industriously, nay, voraciously, "eating crow" for some months past and taking back all it ever said in favor of the syndicate legislation, very much to the amusement of those who remember the same paper's affectionate slobbering over what it now abuses so roundly. It has, moreover, with most manifest injustice, laid directly to the charge of Mr. McKeen every change made by his company in their business whereby any district or class of individuals may have suffered. Mr. McKeen's bitterest opponents must surely see that he is at the present time all that stands in the breach between the people of Cape Breton county and that "soulless monopoly" and "iron-heeled tyranny" (to use their own phrases), and if their recantation of faith in the Dominion Coal Co. is sincere, they must at the same time confess that he is the best friend of every man whose livelihood depends directly or indirectly upon that company.

Some local Liberals have gone so far as to threaten Mr. Fielding with secession, not only from himself and party, but with the total severance of Cape Breton from Nova Scotia and the establishment of a parliament in Sydney which will speedily legislate out of existence the unspeakable tyranny that Mr. Fielding has imposed upon the island,—all of which is very funny. The *Reporter* is rapidly making good its claim to a front rank among the weekly comic papers of this continent. It has made rather a mess of the "company's stores" question. His political enemies say that these stores were forced upon the president and directors, sorely against their wills, by that omnipotent arch-fiend, Mr. McKeen, but the attempt to convince the workmen that their welfare and ultimate salvation were bound up in the extinction of company's stores, was a signal failure as might have been expected. The quarrel has now, however, been taken up by some of the merchants who have formed a league, with the object of bringing pressure on the Local Government to deprive the company of the power they possess under their charter, of running their own stores. If the tone of the *Island Reporter* is any reflection of the feeling of the Liberals throughout Nova Scotia, the Merchants' League has an easy task before it. It strikes us that if these merchants had the business of the company's stores in their hands at the present time, they would be pretty badly "in the soup" by the month of May. Either that or the miners would have been starved in the meantime. If mines' stores are abandoned the step will not be taken in the interests of the men, but of the company.

The bad feeling that undoubtedly exists in Cape Breton in regard to the Dominion Coal Co. is much to be regretted. It is traceable in a great measure, we believe, to the fact that times have been dull and earnings below the average. Money is scarce and everybody is grumbling. The Dominion Coal Co. have turned things upside down and it wfll take some time before people get used to the changes. But given a prosperous year of steady work and we prophesy that the friction will disappear, and we close these remarks with an expression of hope that before another twelve months have passed, even the *Island Reporter* will have ceased to abuse the Dominion Coal Co.

EN PASSANT.

Mr. John E. Hardman, S.B., Mining Engineer, has been offered and, we understand, has accepted the chair of mining engineering at McGill University, vacated by Prof. Carlyle. This is an appointment which will meet with universal satisfaction among the mining profession, and the faculty of applied science is to be congratulated on the acquisition of an engineer of so much ability and wide experience in mining and metallurgical practice. Mr. Hardman, we believe, will hereafter make his headquarters at Montreal, still, howevr, retaining his connection with active mining and consulting work.

Mr. F. A. Halsey, for many years associated with the business of the Rand Drill Company of New York and the Canadian Rand Drill Company of Sherbrooke, will shortly become editor of that very excellent technical journal the *Scientific Machinist*. Mr. Halsey will, however, retain his connection with the Rand company as consulting engineer.

Dr. George M. Dawson, C.M.G., has had the grim satisfaction of perusing in a number of foreign scientific and technical journals several highly eulogistic obituary notices, the esteemed director of our Geological Survey evidently being the victim of an exceedingly unfortunate mistake in the transmission of the announcement of the death of Dr. Lawson, of Dalhousie College, Halifax, another eminent Canadian worker in the field of natural science. Perhaps some of our exchanges will kindly make this correction.

The annual meeting of the General Mining Association of Quebec will be held in the New Club Room, Windsor hotel, Montreal, on Wednesday, Thursday and Friday, 8th, 9th, 10th, January next. The election of officers and council will be held, as in former years, at the morning session on Wednesday. Thursday evening will be devoted to the mining students, for which a number of papers have been entered in competition for the Association's awards. Among the contributors of papers we notice:— Dr. R. W. Ells, Ottawa; Mr. H. P. H. Brumell, Ottawa; Dr. R. W. Raymond, New York; Mr. George E. Drummond, Montreal; Mr. J. S. Higginson, Buckingham; Mr. H. C. Baker, Ba.Sc., Templeton; Mr. J. Obalski, M.E., Inspector of Mines, Quebec; Mr. John Blue, C. & M. E., Capelton; Mr. John J. Penhale, Black Lake; Mr. B. T. A. Bell, Ottawa; Mr. J. B. Hobson, M.E., Vancouver, B.C.; Mr. W. T. Bonner, Montreal; Mr. R. Greene, Montreal; Mr. J. T. Donald, M.A., Montreal; Mr. W, Morton Webb, Montreal; Mr. R. W. Brock, Kingston; Mr. F. J. Pope, Kingston, and Mr. C. Garnett Rothwell, Kingston.

It is generally conceded that the Quebec mining law as it now stands, thanks to our good friend the Hon. Mr. Flynn. is a fairly liberal and equitable legislative enactment, although there still remains on the statute book various clauses which might be abolished with benefit to the industry and investment in minerals. Doubtless Dr. Raymond, probably the greatest authority we have on mining law, Mr. Hardman, and others experienced in the legislation of the countries, will have something of value to contribute to the discussion on this part of the proceedings.

The mining laboratory at the School of Mining, Kingston, has been engaged in testing several lots of gold quartz, and has already demonstrated its usefulness in this sphere. A number of lots have been shown to be too poor to warrant further development, to the great but natural disappointment of the owners. But this was not the case with a quantity lately crushed and amalgamated. The yield was a brick weighing 9 oz. 15 dwt. 9 grs. from 1990 lbs. of rock milled. The mill extracted 94 per cent. of the assay value and produced 185 lbs. of concentrates worth $38.03 a ton. This ore was from the Wahnapitae region.

DOMINION COAL CO. Ltd.—NEW PIT HEAD HUB COLLIERY, CAPE BRETON.

DOMINION COAL CO. Ltd.—DOMINION No. I COLLIERY CAPE BRETON.

St. Lawrence Coal Deliveries, 1895.

We are indebted to Messrs Carbray, Routh & Company, Montreal, for the following comparative statement of the deliveries of Nova Scotia and foreign coal to St. Lawrence ports during the season of navigation just closed. The figures show a marked decrease over the previous year of the returns of lower port coal, while the foreign deliveries were increased by 14,771 tons. This may be accounted for to some extent by the general dullness of trade last winter, but another explanation is to be found in the fact that in 1894 about 30,000 tons were taken from the Montreal market to fill American orders consequent upon the great strike in the U. S During the year about 30,000 tons of slack coal were imported from Great Britain in excess of usual receipts. American bituminous and anthracite (which is admitted free) were sold at lower rates, and the former found a market even at Montreal in competition with Provincial coals. Coke, which is also admitted free, was sold at the ovens in Pennsylvania under $1.00 per ton.

Name of Company.	Montreal.		Sorel.		Three Rivers.		Quebec.		Totals.	
	1894	1895	1894	1895	1894	1895	1894	1895	1894	1895
	Tons	Tons	Tons	Tons	Tons	Tons	Tons	Tons	Tons	Tons
General Mining Association	74,359	73,273	8,485	8,686	3,952	1,843	22,555	31,633	109,351	115,435
Dominion Coal Co	512,269	415,081	3,151	8,223	5,529	7,957	23,173	23,252	544,122	454,513
Intercolonial Coal Co	69,151	66,571	....	....	....	....	....	....	69,151	66,571
Nova Scotia Totals	655,779	554,925	11,636	16,909	9,481	9,800	45,728	54,885	822,624	636,519
Scotch, English, Welsh and American Bituminous (By sea only.)	55,849	79,777	1,932	....	....	....	15,877	8,652	73,658	88,429
Total deliveries	711,628	634,702	13,568	16,909	9,481	9,800	61,605	63,537	796,282	724,948

Gold Mining in Nova Scotia.

We are indebted to Mr. W. H. Brown of the Mines Office for the following returns of the gold reported for royalty since those given in our last issue.

Name of District.	Name of Mill or Co.	Months in which Crushing was done and Returns Made.	Quartz Crushed. No. of Tons	Yield of Gold. ozs.	dwts.	grs.	Total Yield ozs.	dwts.	grs.
Sherbrooke	McNaughton Co	October, November	450	235	10	0			
"	Stellarton Gold Co	November	26	42	17	0			
"	New Glasgow Co	October, November	619	232	5	0			
			1,095	510	12	0	510	12	0
Moose River and Caribou	Moose River Gold Mining Co	October, November	500	140	0	0			
" "	Damas Touquoy	October, November	1,103	70	15	0			
" "	W. A. Sanders	October	712	123	15	0			
" "	A. M. Jack	October	28	28	0	0			
			2,343	362	10	0	362	10	0
Uniacke	Golden Lode	October	25½	224	6	4			
"	John Madill	October	265	22	18	16			
"	D. McDonald	September	22	11	8	0			
			312½	258	12	20	258	12	20
Lake Catcha	Jno. Anderson	November	50	5	10	0			
"	Oxford Mill	July, August	11	19	17	0			
			61	25	7	0	25	7	0
Stormont	Richardson Gold Mining Co	October	892	154	7	0			
"	Antigonish Gold Mining Co	July, August, September	228	90	1	23			
			1,120	244	8	23	244	8	23
Brookfield, Queens	W. L. Libbey Mill	October, November	1,008	715	9	15	715	9	15
Montague	Nova Scotia Gold Mines	July, August, September, October, November	254½	118	5	0	118	5	0
Kemptville	Kemp Mining Co	October	35	10	0	0	10	0	0
15 Mile Stream	New Egerton Co	October, November	1,147	710	18	0	710	18	0
Wine Harbor	W. A. Adams	September, October	248	145	12	11	145	12	11
Gold River	T. N. Baker	October	30	54	6	0	54	6	0
Liscomb Lake	John Powers	November	49	26	7	0	26	7	0
							3,182	8	21
		Reported in last issue					13,249	15	8
		Total					16,432	4	5

The second volume of Transactions, being the journal of the Association for the years 1894-95, was issued to members on 13th instant. It is a highly creditable production, nicely bound and illustrated, the contents extending over some 300 pp., containing many papers of interterest and value to the mining operators of the Dominion.

Mr. Frank T. Shutt's able paper on "Phosphoric Acid in Agriculture," contributed at the Quebec meeting and published lately in these columns is, by order of the Hon. Minister of Agriculture, being reproduced in the annual report of the department. The Quebec and Ontario Governments might emulate this example with advantage to the farmers and the phosphate and fertilizer industries.

Mr. W. A. Carlyle, M.E., left Montreal on 26th instant to take up his duties as mineralogist to the Government of British Columbia. Needless to say the hearty good wishes of a large circle of friends in the mining profession follow him to his new sphere of labor.

The interpretation of the law respecting the free admission of mining machinery still creates friction at a number of ports of entry, and a strong and united effort will shortly be made to have this matter placed upon a more uniform basis. In all likelihood a deputation will inter view the Government early next month.

Rapid progress is being made with the construction of the smelting works at Trail Landing, B.C., and the first furnace will be blown in some time this month. Mr. F. A. Heinze, of the Montana Ore Purchasing Co. at Butte City, Montana, the owner of the works, has kindly furnished us with the following particulars :

"The capacity of the smelter will be in the neighborhood of 125 tons daily. It is located on the bluff of the Columbia River, just above the town of Trail, and will be connected by some 15 miles of railroad, narrow guage, with the town of Rossland. The plant proper consists of 150-ton sampling works and O'Hara calcining department, containing O'Hara furnaces and circular calciners of the most approved pattern, and a smelter building 70 feet wide by 130 long, and 40 feet from the sill to the bottom of the chords of the building. This building will contain two reverberatory furnaces of the most approved pattern and design, as lately erected for the Butte smelting practice, and one blast furnace. The works, besides the individual reverberatory stacks, will have a large stack connecting with the calciners and blast furnace dust chambers, which will be 16 feet square at the base (outside diameter), and 150 feet high, containing half a million brick. As soon as the buildings are completed and the stacks up we will be pleased to forward you photographs. The works when completed will cost a little over $200,000.00."

The Eastern Development Co., Ltd., owning the Coxheath copper mines, Cape Breton, is being reorganized under name of the Cape Breton Copper Company. Captain Gragg, of Boston, one of the principals, and Messrs. Macdougall and Gillies, members of parliament for the county, were in Ottawa the other day making arrangements for the new works, which, we understand, are to be built forthwith.

One of the most striking improvements that have taken place in the iron trade of late years has been the economy in the consumption of coal for all metallurgical purposes. The average consumption of coal in the pig-iron industry of Great Britain was as as follows in each of the years 1873 and 1894 :

	Tons.
1873	2·54
1894	2·00

From which it follows that in twenty years the Mother Country has saved more than half a ton of coal for every ton of pig-iron smelted. On an output of over 17½ million tons a year—which this year will witness—this is a considerable item.

The German papers give some interesting accounts of the means taken in the Dortmund district to provide miners with the means of changing their wet, dirty clothes on leaving the mines, and washing and dressing before they go home. A series of experiments were made as to the best methods of enabling the miners to perform their ablutions, and dress before going home. At first opposition to the baths was experienced, and then the benefits of the plunge baths were recognized, and crowds of miners availed themselves of them, and it was found that a great deal of water would be required. Finally the shower bath was seen to be the bath of the future, as less water was required a greater number of men could be accommodated ; they had all privacy, and the rain drops falling on the body exercised quickly a cleansing effect. Now there are provided in the Dortmund district alone 209 lavatories at 167 galleries with 22 shafts, and they afford full washing accommodation to 132,450 men, or about 95·7 per cent. of the entire mining population.

The ironworks of Mr. F. Buttgenbach are situated on the left bank of the lower Rhine, in a regular thunderstorm track, and are hence amply provided with lightning conductors, which are duly tested from time to time. In spite of this, the men often reported that lightning struck the heaps of iron on the yard or went down the blast furnaces far more frequently than it appeared to travel down the much higher lightning conductors close by. This year, Mr. Buttgenbach, who takes a special interest in meteorology, had an opportunity of convincing himself that his men were right. He was standing near the mouth of a furnace in operation when a storm approached. He was suddenly knocked down ; several others nearer the mouth were stunned for some moments, and declared that they say a column of fire rush down the furnace. A dense cloud of smoke and dust followed the flash. The men down below came up because they heard a terrible roar, which they ascribed to a stroke of lightning. The slag which had been flowing sluggishly streamed out more rapidly for some time. Chemical analysis revealed nothing abnormal, and the furnace did not show much damage.

The mention of hoisting speed of 1,700 feet per minute, in a Hungarian mine, in a recent report, has called out some interesting facts on this subject. The following communication is from W. M. Ruth, of the Edward P. Allis Company, of Milwaukee, Wisconsin :

"I notice in a recent number an item on the hoisting speeds employed in a Hungarian mine, *i.e.*, a speed of 1,700 feet per minute, or 19.3 miles per hour. At the Tamarack mine, in the Lake Superior copper region, thirty-nine cars per hour were recently raised from a depth of 3,186 feet for six consecutive hours. This is equivalent to an average hoisting speed of 3,180 feet per minute, or 36.1 miles an hour, allowing a trifle over one minute for loading and unloading the cages. The load of rock 6,720 pounds. This work was performed with a direct-acting or first motion hoisting engine made by the Edward P. Allis Company. The steam cylinders are 42x84 inches, and the hoisting drum 30 feet in diameter. It has been in service several years. At another shaft owned by the Tamarack Mining Company, a trip was made some days ago, from a depth of 4,500 feet in one and one-quarter minute, equivalent to a speed of 3,600 feet per minute, or nearly 41 miles an hour. At this shaft, the engine, which was also built by the Edward P. Allis Company, is 32x84 inches, and the hoisting drum, a double cone, 13½ feet and 36 feet diameter ; each cone will carry 6,000 feet of rope. For short periods speeds as high as 4,200 feet per minute have been observed."

This year Florida will market not less than 325,000 tons of high grade phosphate. This output will be increased next year about 15 per cent. About 80,000 tons are now on hand, and practically all of this has been sold at prices ranging from $4 per ton for 78 per cent rock to $3.25 and upward for the 75 per cent. grade.

Two things confront the phosphate miners in Florida today : first, the low price of the product, caused by over production ; second, the really great danger of the extinction of many of the mines, and the necessity of having to find new grounds for the expensive plants which must before long be moved. The ruling prices today are very low. The shipments from this State for the year will approximate 325,000 tons, with an estimated increase of 25,000 to 50,000 tons additional in 1896.

MINING IN BRITISH COLUMBIA.

The Secretary-Treasurer of the Kootenay and Columbia Prospecting and Mining Co., Ottawa reports the following smelter returns on four carloads of ore shipped from the Wellington mine, Slocan district :—

1st shipment.	27,780 lbs., 175.4 ozs. silver	$1,186 99
	4,915 " @ $83.24	198 24
2nd shipment..	31,830 " @ 73.67	1,172 45
3rd shipment..	20,992 " @ 150.26	1,577 12
4th shipment..	34,155 " @ 172.47	2,907 96
		$7,042 76
	Less cost of extraction	3,002 00
	Net profit	$4,040 76

The last shipment gave 320 ozs. silver and $14\frac{6}{10}$ % lead to ton of 2,000 lbs. The first two cars went to Canadian smelter at Pilot Bay and the last to United Smelting Co., Smelter, Montana.

The working force on the Wellington will be doubled next month. Eleven men are now employed. A shipment made the beginning of this month returned 158 ozs. silver and 15% lead, and netted $1,166.14, sufficient to pay expenses for the month.

The Le Roi Mining Co. is said to have declared another five-cent dividend on December 1st.

The mining companies registered to do business in West Kootenay since January 1st, 1891, have a combined capitalization of $35,675,000.

The management of the Le Roi mine believes in the diamond drill. Recently a trial was made of six days at a cost not to exceed $100, which would have required not less than sixty days and an expenditure of $1,200 in the old way. In the Silver King mine at Nelson all of the exploring is done with diamond drills. Recently they sent the drill across the ledge and at 300 feet the ore body was 8 feet wide. From a different point the drill was sunk to 600 feet and the vein was 9 feet wide, and at 800 feet the ore body held its own. There is no uncertainty about this ; the owners know that they have ore at those depths.

The brick work on the Trail Smelter has not progressed as rapidly as was expected. The furnaces will not be ready by January 1. The Smelter Company is now receiving ore as per their contract from the Le Roi and more than 10,000 tons are already piled up.

The Canadian Pacific Mining and Milling Company has completed its wharf at Woodbury creek, and some 28,000 feet of lumber for a flume have been delivered. The force is busy at present putting in the timbers for the flume and power building. The water wheel and compressor are expected next week, having been shipped from San Francisco some ten days ago. This mine will soon be a shipper, a large body of ore being reported in sight.

At the Hall Mines smelter at Nelson, the office and assay building is nearly completed, the sampling works building is ready for the machinery, the boiler and engine room looks as if steam only was needed to set the machinery in motion, the frame of the furnace building is up, the flue-dust chamber is completed, a reservoir that will hold 25,000 gallons of water is nearly completed, the sidehill grading for the railway spur will be finished in a few days, a boarding-house is enclosed, the tramway is delivering ore, and it looks as if the smelter would be in operation by New Year's day.

Arrangements have been completed for the erection of a cyanide reduction works at Bakerville. The plant will be used for treating the ores of the Black Jack Quartz Milling Company, and any that may be sent for complete mill runs. The milling, as far as cyanide is concerned, will be under the management of the Cassel Gold Extracting Co., of Glasgow, represented by W. Pellew-Harvey, F.C.S. The resident manager will be Mr. S. J. Marsh. The plant will be built at once by the British Columbia Iron Works Co., of Vancouver. It is not at all unlikely that a mill will be erected at Alberni, B.C., under the same auspices, as the Alberni ores have proved particularly amenable to the cyanide process.

The first claim in the Slocan was located on Sept. 9, 1891, and recorded on Sept. 26. During the balance of that year 191 claims were recorded. In 1892 the number reached 633, in 1893, 398 ; in 1894, 270 ; and in 1895, with part of the year yet to be heard from, the number has been 635 ; making this the banner year since the famous district was first discovered.

Since 1891, forty-eight mining companies have been incorporated in the West Kootenay district, with a capitalization of $35,675,000. The largest of these are the Le Roi and Hall mines, limited, each with a capital of $2,500,000. There are four companies with a capital of $2,000,000 and over nine of $1,000,000, one of $800,000, one of $600,000, nineteen with $500,000, one of $400,000, four with $250,000, one of $225,000, one of $200,000, six with $100,000, and one of $50,000. This is considered a pretty good showing for a district not five years old and shows the great possibilities of the country. There are other mines not incorporated which will be thoroughly developed next year, and no doubt add largely to the wealth of the district —mines in new districts which have been discovered during the past summer. In fact, there can be no estimate made of what the next season will do for West Kootenay. With the increased transportation facilities now being offered there will be increased production.

The memorandum of association of the British Columbia Pottery Co., Ltd., is published in the British Columbia *Gazette*. The trustees are James Dunsmuir, Charles A. Vernon and Joseph Hunter, of Victoria, and the principal place of business is 22½ Pandora street, Victoria. The capital stock is $150,000. The object of the company is to acquire the business now carried on under the name of the British Columbia Pottery Co.

In the fore part of the year the *Tribune*, Nelson, estimated that the output of the mines of Kootenay for the year 1895 would be worth $3,000,000. That estimate is not far wrong. It now predicts that the output in 1896 will be worth $10,000,000, and makes the following estimates :

	Value of Product
Hall Mines smelter, Nelson	$1,725,000
Pilot Bay smelter	725,000
Heinze smelter, Trail	1,460,000
Slocan Star mine, Sandon	1,825,000
Alamo concentrator and mines, Three Forks	730,000
War Eagle mine, Rossland	1,460,000
Josie, Crown Point, and other Trail Creek district mines	730,000
Noble Five, Reco, and other Slocan district mines	912,500
Poorman and other gold mines at Nelson	50,000
Mines at Ainsworth, in addition to ore shipped to Pilot Bay smelter	100,000
North Star and other mines in East Kootenay	273,750
Placer mines in East and West Kootenay	50,000
Total	$10,040,750

The Le Roi has had a compressor plant for some time and has had a number of power drills at work. The company, says the Rossland *Miner*, has just added a diamond drill to its equipment, and this, driven by an electric motor, is doing some fine prospecting work on the west end of the Le Roi ground. The new drill plant of the War Eagle will soon be installed. It will have a capacity of twenty drills and will be one of the most substantially constructed plants in the country. This will be in operation by January 1 and will revolutionize the output of the War Eagle and its associate properties. The Center Star Company will have its seven-drill plant ready for service within thirty days. The building is complete and the machinery all on the ground ready for installation. A two-drill plant has just been set to work on the Lee and Maid. If the Cliff deal goes through a drill plant will be put up on that property immediately. The same can be said of every mine to be worked by the English syndicate for whom J. H. Clemes is acting. The largest drill plant of the camp will probably be put in for the Kootenay and Columbia. The Trail Mining Company, the owners of these properties, will send here one of the thirty-drill compressors now in use by Messrs. Mason, Hoge & Co. on the big Chicago drainage canal. This plant will be installed as early next spring as the machinery can be got in. Both the Crown Point and Iron Horse Companies have asked for bids on supplying drill plants and these bids have been handed in. Neither plant will be of less capacity than five drills. Arrangements have been made by both the Josie and the St. Elmo Companies to put in compressors.

The Fishback Hydraulic Gold Mining Co. has been incorporated at Seattle, Wash., with a capitalization of $300,000, by J. H. McGraw, J. P. Hoyt, C. H. Fishback, H. G. Struve and M. McMicken, to operate in British Columbia.

The St. Mary Mining Co. has been incorporated at Spokane by V. D. Williams, C. S. Voorhees, J. L. Wilson, R. H. Voorhees, of Spokane, and J. H. Burke, of Rossland, the objects being general mining in British Columbia.

The owners of the Yakima group and Cumberland mine, Slocan district, have organized two companies to work these properties. The one to work the Yakima group is called the Sunshine Mining Company and the one to work the Cumberland is called the Cumberland Mining Company. Each company's capital is $500,000 and both have the same officers, namely, W. H. Yawkey, president ; N. D. Moore, vice-president and manager ; and W. C. Yawkey, secretary and treasurer. Head office of both companies, Three Forks.

The Horsefly Hydraulic mine has been shut down for the season. It is reported that the recent and last clean-up at the Horsefly will net about $7,000 or $8,000, which will bring the output of the mine up to about $49,000 or $50,000 for the present year, and an additional clean-up of $6,000 for last season would aggregate $55,000 or $56,000 as the total output of the mine. The running expenses of the mine are about $7,000 a month since its equipment, so that enough has been taken out to pay for one year's work on the mine. When it is considered that only about 60 or 70 days' piping all told gave the above output mining men will agree that the Horsefly is a good producer. The physical difficulties have been great, however, and it is a matter for congratulation that the cement which gave so much trouble is about run out. It has been followed to a thin streak that cannot now give any trouble to speak of, and it is not probable it will be met again in the direction now being followed. Everything at the Horsefly is in readiness for work to commence as soon as the frost vanishes next spring.

A correspondent writing from the Cariboo district says :—" Mining here is yet in its infancy, although over $50,000,000 has been taken out of the creek, yet if all the ground which has been mined either by drifting or hydraulicing were put side by side it would not average over five miles square, and I think I am within a safe limit when I say it would not amount to more than that. In my opinion they have not commenced to mine here yet. There are many places that twenty-five years ago it would not pay to work, which today would pay handsome dividends. You can take a pan of dirt anywhere on the hillsides, even in the rocks, and get colors of gold—sometimes three, four and five cents to the pan. But the great drawback to mining here is the lack of means to bring the water to where it is required for hydraulicing ; and, on the other hand, the presence of too much water in the miles and miles of unworked streams whose bottoms have never been worked because the water could not be kept down. The cost of pumping was too great in the olden days. When one mine stopped pumping on any creek, all had to stop. In these days of electricity, however, we may look for a revival of mining in the old deep workings which will surprise the world with their hidden treasures. Already borings have been put down to test some of the creek bottoms, and the prospects obtained have been astonishing, some of which I will give later on. The Cariboo Gold Fields Company is rushing its flume to completion, and by the end of the month will have it ready for blocking. There are about seventy men at work for the company in the woods, and on the flume and at the mill. Peter Egan is rushing out the lumber from his portable mill for the works, and there are four teams of four horses each hauling lumber and timber. Another contract for 150 feet of a tunnel on the Pincess group of claims, owned by the Cariboo Gold Reefs Company, has been let to Mr. Blackwood, who now has a force of men at work driving day and night. The first contract of 100 feet having proved profitable, it was decided to go on with the present work. The Cariboo Gold Fields Company is also driving a tunnel on a ledge on Prosperpine mountain, which is showing up in good shape. There have been some very fair samples of ore brought in this summer as the result of careful prospecting, and some of them have yielded well in assaying, more of which I will tell you when I come to quartz."

COAL MINING IN NOVA SCOTIA.

General Mining Association (Limited)—Mr. R. H. Brown, manager of the Old Sydney mines, has kindly furnished the following particulars of operations during the year:

"An air compressor (Ingersoll, 14¼x18 in.), has been set up on the surface to pump the water from the 'dip' portion of the workings to the shaft bottom. The air is carried a distance of one mile underground to the furthest pump. This air compressor also operates two coal coal cutting machines, (an Ingersoll and a Harrison), this being the first application of machinery to coal cutting at this colliery. Steam is supplied to the air compressor by a tubular boiler at a pressure of 75 or 80 lbs. to the square inch. The underground pumps employed in connection with the air compressing plant are a Northey, 7½x4x10 in., and a Worthington, 4½x2¾x4 in.

The old pulley legs and pithead frame at the pumping shaft at Princess pit, where the workmen are lowered into and raised from their work underground, have been replaced by new ones, made of pitch pine.

A bore-hole five inches in diameter has been put down to a depth of 155 feet for obtaining a supply of pure water for the use of the workmen of the colliery.

Ten new cottages of improved design have been this summer added to the large number of houses for workmen at the colliery.

The superstructure or trestle work of our eastern pier at the loading ground at North Sydney, has been replaced by new, of increased height and with new drop and shutes for shipping the coal. The approach to this pier over the public road has also been renewed; rolled steel girders with pitch pine supports taking the place of the oak stringers hitherto used.

As for our output of coal I hope to make it 250,000 tons, though if December shipments do not come up to last year's we may fall short of that quantity. There is no predicting what December's trade may be. Of course an output of 250,000 tons does not mean a sale to that amount, for a proportion of the coal must always be used for working the mines and providing the workmen with fuel gratuitously. For instance in 1894 our actual gross output was 256,000 tons, while our sales were:

Shipped	218,028
Sold to Intercolonial Railway	4,756
Other sales by land, &c	9,159
Total number of tons sold	231,943

The labor employed at this colliery for the year 1895 may be put down as 490 men and boys employed underground, and 265 men and boys on the surface.

Acadia Coal Co., (Limited)—Mr. H. S. Poole writes:—The Acadia pit took some time to get into full operation again after the surface fire, but it is now equipped with a more thorough screening apparatus than before, Briart and other shaking screens and picking belts. At the Vale there has been no change whatever. At the Albion the Foord pit continues to be used as a pumping station only for the rest of the works. The fan at the third seam has been replaced by a Walker's Indestructible, driven by a compound engine of greater capacity.

Chignecto Colliery—This colliery has been operated in a small way, under lease, by Mr. James Baird, and the shipments for the year will not exceed 600 tons.

ASBESTOS AND CHROMIC IRON.

(From our own Correspondent.)

There has been the usual amount of activity at the asbestos mines of Thetford and Black Lake during the season just closing, and the output in most cases has been up to former years. A small falling off may be noticed in one or two instances, but on the whole I believe the output for 1895 will probably exceed that of 1894. Prices range about the same as at the beginning of the year.

Improvements in the methods of cleaning the fibre have reduced the cost of this branch considerably, enabling the miner to place a very clean, superior grade on the market, and at the same time to recover all the short fibre which, under the old system of hand cobbing, was sent over the dumps.

Bell's Asbestos Co., at Thetford, have a very complete mill for cleaning fibre and are able to turn out a large quantity daily, in addition to the standard grades, produced from their mine.

Johnson's Co., also, have a well equipped plant, and prepare a quantity of short fibre for the market in addition to the higher grades.

These two mines, with Messrs. King Bros., are the only ones operating at Thetford Mines, the Beaver Asbestos Co. having closed down early in the year.

At Black Lake the Anglo-Canadian Asbestos Co., the American Asbestos Co. and the United Asbestos Co. have been working during the season with about the same force as last year. Nearly all the pit work has been suspended for the winter, but all the mills are still in operation cleaning up accumulated stock.

The American Asbestos Co. are making some improvements to their plant and putting in some additional plant for preparing fibre.

At Danville work is being carried on with a large force of men and many improvements are being made in addition to the large fibrizing plant in course of construction.

Some work has been done in the neighborhood of East Broughton by two or three parties during the summer, but chiefly of an exploratory character. The United Asbestos Co. have been doing some work on the lots owned by the Glasgow and Montreal Asbestos Co. Some splendid fibre has been taken out of the Fraser mine, and we understand that this property has been leased and will be operated by the United Asbestos Co. next year. Another lot has been explored and opened up by Messrs. Trottier, Briere and others with fair success. Some work has also been done on the property of Messrs. Walsh and Mulvena at the same place.

Chrome iron continues to occupy the attention of the people in the Black Lake district, and the output from the various pits during the past summer has been very steady. The shipments of this mineral for 1895 have been much larger than last year and will reach 3,000 tons. The demand for good ore continues, and a ready market is found for 48% and upward. There is also a fair demand for low grade ore.

At the Brompton Lake Asbestos property at Brompton work has been resumed, and we understand will be continued during the winter. This property, it will be remembered, was worked some years ago by the Brompton Lake Asbestos Co., comprising chiefly Montreal and Quebec parties. This property has recently been leased from the above company by a party of Boston capitalists for a term of seven years, and we understand that a strong force of men will be employed during the winter under the direction of Mr. John McCaw of Sherbrooke.

MINING IN ONTARIO.

The Black Donald Mining Co. is the name of an Ottawa company just organized to mine graphite in Renfrew county, Ont. The principals comprise: G. P. Brophy, J. W. McRae, S. H. Fleming and Hector McRae, all residents of Ottawa. The property comprises lots 16, 17, 18 and 19, township of Brougham, and is located at White Fish Lake, the purchase consideration, we understand, being $30,000. The deposit is one of great promise, and of very superior quality. Some 320 feet have been stripped, giving an average width of workable material about 20 feet, while the depth, as ascertained by diamond drill boring at date, is something like 61 feet of solid graphite. The analyses range from 65 to 88 per cent. carbon. The mine is equipped with steam drills, hoists, boilers, pumps, etc., and is now in full working order. 1,500 tons of ore will be shipped to Calabogie station, Kingston and Pembroke Railway, this winter.

The new iron-smelting works of the Hamilton Iron and Steel Co., Ltd., at Hamilton, are approaching completion, and are expected to be in full blast early in the incoming year. They have been in course of construction for the past three years. The plant will be in every respect up to date, with modern furnaces, machinery and appliances, and both railway and shipping connections direct to the works, and will be capable of producing 3,000 tons of cast iron pig per month. The blast furnace, hot air ovens, gas-fired steam boilers, forced blast engine, steam hoists and handling tackle are built and erected from the most recent designs, so as to economise as far as possible the labor of the employees, and improve the quality of the output. About 300 tons of iron ore, 120 tons of coal or coke, and about 30 tons of limestone and other materials, will be required daily, including Sundays, to keep the works in operation. A very large proportion of the ore will be mined in Canada; still there will be a considerable quantity imported to get the grades of iron required by the trade. The company will have their own locomotives to handle the materials at the works, having provided every facility to receive the ore, etc., from vessels or from their railway connections, either incoming or outgoing. These works stand nearly in the centre of the iron-consuming district, and the company claim that they will be in a position to supply iron with greater advantage to the consumer than any of its Canadian competitors. It will be the means of centering and distributing a large amount of money in Ontario that would leave it for imported iron, and as Hamilton is a manufacturing centre using a large quantity of iron, it will have a tendency by reason of the cheapness and proximity of these works to bring other iron-using industries to this city.

One of the best known gold mines in the Lake of the Woods district is "The Regina," operated by an English company, of which Lieut.-Gen. Wilkinson, C.B., is president, and Mr. W. G. Motley, M.E., the resident manager. The company was organized under the name of the Regina (Canada) Gold Mines, Ltd., with a capital of $750,000. The mine is situated on the south side of White Fish Bay, a part of the Lake of the Woods, about two miles from the Hudson Bay trading post, and 45 miles from Rat Portage. The property comprises an area of 200 acres, 76 of which are owned by the company, the balance being operated under a mining lease. There are five partly developed veins, known as numbers one, two, three, four, and the west vein, the latter being a recent discovery. At present operations are centered on number three vein. This is what is known as a true vein. It cuts the granite formation, slightly dipping to the west, and has a trend to north, ten degrees east and south, ten degrees west. At 300 feet from the lake shore the country rock changes to altered trap, and from this point the vein takes its course between the two formations, forming a contact vein, which is traceable on the surface 750 feet from the lake front, and having an average width of 2 feet 6 inches. The character of the ore is quartz carrying free gold, and is easily treated with a stamp mill.

The Regina is being rapidly developed by means of a tunnel, 7 by 5 feet, now drifted 120 feet from the main shaft, which has opened up 54 feet of ore preserves above the tunnel. The main shaft has been sunk to a depth of 75 feet, and two levels are now being drifted at a depth of 60 feet. The north level has been extended 25 feet and the south one 45 feet. The south drift will form a connection with the winze, or air shaft, now being sunk in the tunnel 75 feet from the main shaft. The winze is already down 40 feet, and when completed will give perfect ventilation to the lower workings, in addition to providing means of escape in case of accident to the main shaft. The main hoist is 6 feet square and the manhole 6 feet by 4 feet. The latter is thoroughly fitted with substantial ladders and strongly partitioned from the hoist, in order to protect the men from rock liable to fall out of the ore carriers.

A modern ten-stamp mill has been erected on the property, right on the lake shore, and is now operating night and day. The mill is of the Homestake pattern, with inside amalgamation, the stamps weighing 900 lbs. each. The concentrating tables are of the Gilpin county type, and the slime floors were specially designed by the company's manager. The mill is fitted with a No. 7 Blake ore crusher and two Tulloch automatic ore feeders, the whole outfit making one of the most substantial and best arranged mills in Canada. All of the buildings, and even the road leading to the camp, are thoroughly lighted with electric light, the effect as seen from the lake being not only pretty but impressive.

The ten-stamp mill which this company have erected on their property at the Regina mine has been fitted up with the most modern mining machinery supplied by the Gates Iron Works of Chicago.

At present 45 miners are steadily employed, the result of their labors being the production of a good-sized gold brick, which is brought in each Monday and shipped to the United States mint at New York. Thus far the results have been most satisfactory and the prospects are steadily brightening.

The Training of an Engineer.*

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By Mr. Archibald Denny.

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The first question I should like to touch upon is the education proper for a budding engineer, and naturally all through you must take my remarks to refer principally to the two professions of shipbuilding and marine engineering, while I believe you will find them to have a direct application to the other branches of engineering. Each man has his own idea as to what the education of an engineer should be, and I observe that many of your past presidents have dealt with this subject from their point of view.

I think all young men should start with a good English education, with Latin and Greek not a necessity, and indeed, curtailed to the minimum possible. I must say I am not in love with the prevailing system adoped in most English and some exotic schools in Scotland, where Latin and Greek occupy about four-fifths of the boy's time, and recreation roughly the other fifth, and I am glad to think that the modern board school, especially in Scotland, is doing much to leaven the whole lump.

Mathematics—at least the elements of it—and the elements of mechanics, chemistry, and physics should be thoroughly mastered, so that at the age of sixteen, or at least seventeen, provided the boy's physique is fairly developed, his apprenticeship might begin.

Now I think it must be beyond dispute that, given a lad who intends to tread the higher walks of the profession, and not merely to begin and end as a workman, it is not necessary that he should spend five years at the bench to learn his trade, to gain sufficient expertness in handling the tools and to study practically the qualities and properties of materials ; hence my ideal course is as follows :—

Begin by spending alternately six months (the six summer months) at the bench and then six months (the winter months) at a first-class technical school or college. As the college or technical school course is generally one of three years, at the end of this time, or in four years at most, the youth should have had enough of the bench and should be quite ready for the drawing office ; the shorter period should suffice in the shipbuilding yard and the longer period for the marine engineer.

If a shipbuilder, then he must remain in the drawing office or fight his way up through manager to principal as his ambition, opportunity, and ability lead him. If a marine engineer, then after a year or two in the drawing office, he should certainly proceed to sea, and, if possible, get his chief and extra chief's certificate, and thereafter work his way upwards on shore.

This is my ideal course roughly sketched, and one which is being followed out in our yard and engine works whenever possible. Of course, every man cannot afford or has not the opportunity of following out this course ; then all that can be done is to study in the evening (not too late an hour) and take evening classes. Some of our most brilliant men have succeeded in this way alone, but who can say what they would have been if they had had the advantage of such a course as I have sketched out ?

Endeavour to be apprenticed, if possible, to a firm who do not take premium apprentices. The policy of taking premium apprentices is, in my opinion, a mistaken one, both for the employer and the apprentice. The foreman in the works, and the heads of departments generally, have the feeling that premium apprentices must be more leniently treated than the ordinary apprentice, and this feeling is sometimes so strong that we need not wonder at it reacting upon the premium apprentice, and inducing a state of indifference in those who do not start with strong moral fibre. If there are many premium apprentices their effect on discipline in the works must be detrimental, and even supposing that a few out of the many have a higher ideal than their fellows, it is difficult for them to strike out a different course of action from that of the majority. Not having had personal experience of premium apprentices, my views upon this subject may be rather strong, and I know that many young men find it impossible to learn their profession by any other means ; but I think it would be an improvement if firms who do take premium apprentices made it a rule that these apprentices were to be treated in exactly the same way as ordinary apprentices—paid the same wages, expected to fulfil the same conditions, and to be advanced only as a reward of real merit. In that case the premium apprentice would either, as the result of lack of application, simply finish his time an ordinary workman ; or as it should be his superior initial education, with equal application, would ensure his being advanced more rapidly than those who started with fewer advantages, through the drawing office to a position of trust. I have great sympathy with premium apprentices. I think their surroundings render it difficult for them to do their duty, and the spur of necessity is laking in many cases, but this is all the more reason why I should point out the dangers and impress the necessity for facing the difficulties and dangers of the position with a strong determination to overcome them.

During apprenticeship, a lad will doubtless have many opportunities of bringing himself prominently, by good work and conduct, to the notice of his employer and foreman, but while he should seize every favourable opportunity of doing so, he should avoid making himself objectionable by pushing himself forward in season and out of season. To do so will only disgust his superiors, and gain him the dislike of his fellow-workmen. Favorable opportunities of bringing himself before the notice of his employer will occur most frequently when in the drawing office, and the best opportunity is when he is given a piece of investigation work, involving probably the carrying out of experiments. If any of you are ever in this position you should be most careful in carrying out the experiments ; only draw conclusions after these have been confirmed by a frequent repetition of experiments. Some men have a natural bent towards experimenting : it seems natural to them to tabulate an experiment in the best possible way, and their work at completion is so thoroughly well digested that the results are easily assimilated by the principal, and hearty commendation follows. Under these circumstances it is certain that this man's services will be frequently requisitioned ; he is thus brought in close contact with the principal, and his rapid advancement ensured. Such cases have often occurred in my own experience. The careful and accurate man appeals to one immediately, and if this is combined with rapidity in carrying out work his services are highly prized.

Another point I want to notice, and one which has been already touched upon by a recent president, is the question of loyalty to your employers. Undoubtedly this is one of your first duties, and a duty that you owe not only to your employer, but also to yourself, because an act of disloyalty to your employer is realy an act of degradation to yourself, even if not found out, a constant repetition of which will so undermine your moral character that you become an object of contempt to yourself, which appears to me a more serious thing than being an object of contempt to your fellow-men ; indeed the latter only becomes possible long after the former is an accomplished fact.

I know it is the practice of many draughtsmen to appropriate information from the drawing office in which they are employed, to copy plans and tabulated data. Now this, in my opinion, is immoral, besides which I consider it, so far at least as plans are concerned, and also as far as a good deal of tabulated data is concerned, a great waste of time. I have a friend who was once a draughtsman, and he has told me that there are now in his possession many plans cribbed in this way, and that he was incited to do this by the needless prohibition and difficulties placed in his way by a suspicious employer. As a matter of fact, he did not gain any advantage from this as from the day he cribbed them till now they have never been looked at.

Progress is so rapid nowadays that the mere copyist will always be left behind, and if a man has not sufficient ability from his past experience to scheme out improvements he will soon be left in the rear along with his cribbed information. May I read you a few sentences from the general order book in force in our yard ?

"As there is growing in our office a large amount of special and organized information, procured and organized at considerable expense by us, it must be clearly understood by every member of our staff that we consider this information private, and to be used only in our service. Any member of our staff found copying or removing any of this special organized information will be considered to have acted against honour, and will, on our coming to know his action, be immediately and without further warning expelled from our offices. To such a person we will decline to give either reference or character. We consider that the opportunities afforded to the members of our staff in their ordinary work and for private study by our library are sufficient to enable them to acquire a knowledge of all methods of working, by means of which, should they leave our service for that of some other firm, or to start on their own account, they can collect and organize information for their employers or for themselves. There is therefore no excuse for their acting against honour in the way we have now forbidden."

I think these sentences put the matter very clearly and fairly, and may assist young men in deciding upon their course of action. I would therefore counsel you to gain experience, and store it in your brain, and make notes only of such general principles as you find in use or discover for yourselves, and do not run the risk of lowering yourself in your own estimation by taking that which is another's.

You should be absolutely loyal to your employer while with him ; identify yourself with him in every way, and make his interests yours ; and when you leave one employer to go to another, you should carefully consider how much special information you shall impart to your new employer, more especially if he happens to be a rival to your last.

I would like to give another warning to young men. Cases have come to my knowledge where foreign competitors have by specious promises induced able young men to leave the employ of a specialist in this country, so that he might assist a foreign rival in establishing a similar business abroad. The object was perfectly apparent, and was recognized by both parties—I mean both the foreigner and his dupe. A much larger salary was fixed than he was in receipt of previously, with an agreement for a certain term of years. Everything went smoothly until the information possessed by the young man was transferred to his new employer and then the position became uncomfortable, in fact, so uncomfortable that, long before the expiry of the agreed-upon term of years, the young man was glad to leave and return to England, sadder and wiser.

A last hint, and one which I have often found it necessary to give—hold your tongue about what goes on inside the drawing office, especially in regard to proposed work. It frequently happens that, from the lack of this precaution, information passing from one drawing office to another induces competition of an unfair nature, which otherwise might have been avoided.

Now, if you become chief draughtsmon, you will for the first time have control of a number of other men, and you have added to you a serious responsibility in the management of them. Some men are by nature fitted to rule others ; other men—good men, no doubt—are by nature quite unfitted to do so, but much can be done to correct this latter imperfection. Constant remembrance of the golden rule, "Do as you would be done by," will help ; treat those under you with kindness and justice, but, at the same time, you must be firm in enforcing rigid discipline. One fault which principals find it difficult to excuse, and which should always be avoided, is shunting the responsibility for mistakes on to a subordinate, with the remark :—"I am very sorry, but Mr. So-and-so made the mistake." This is most disagreeable, and points to a lack of manliness.

A chief draughtsman should take the entire responsibility of the work passing through the office ; should take the blame of any mistake upon himself, and not endeavor to shunt any blame on to the shoulders of a subordinate. This should not prevent him at the same time from passing on the remarks of the principal, with a few additional ones of his own, in order that the same mistake may not occur again.

Be punctual yourself, and insist upon absolute punctuality in your subordinates. When several pieces of work appear equally important, and it is a question in your mind which to tackle first in the morning, choose the one you like least, and, this once finished, the others will go down before you like corn to the scythe of the reaper ; this is a golden rule, imparted to me by my late brother, which by long experience I have found invaluable. You will find it a useful thing to keep an agenda or question book, and go over it every day yourself, also, if possible, with your superior, noting his instructions.

Suppose now that you go a step higher, and become manager. Your responsibility is further increased, and you have now a new set of conditions to deal with. You should still more closely, if possible, link up your principals' interests with your own. The most serious part of your duty will be in maintaining discipline in the works. Man in general is a most complicated machine to deal with, and the working man is perhaps the most complicated machine of the human species. In most machines, given a certain set of conditions, you can predict what will happen when the machine works, but often with the human machine exactly the reverse happens to what you might have expected. No minute rules can be therefore laid down for the management of men, but you will go a long way towards success if, following out the treatment of your men in the drawing office, you deal with the men in the works in a firm but pleasant way. Be definite in the orders you give, and see that they are promptly and cheerfully carried out. Do not be unreasonable in your demands, and in all your dealings with the men, and the arrangements you make with them, be perfectly honest and straightforward, trying if possible to put yourself in their place. If you have profited by your time at the bench you will not find this very hard to do. Where necessary, make written notes of any arrangements as to wages, etc., immediately they are made, read them to the men, sign them yourself, and get them to countersign. Leave nothing ambiguous, nothing doubtful, and, if possible, deal directly with the men and not with paid agents. You will find, under these circumstances, that, with few exceptions, the working man is to be trusted and admired.

You will find it advantageous to spend an hour in the factory before breakfast. An hour thus spent is worth two later in the day, when it may be difficult to spare the time, pressed as you probably will be by other business, visitors, outside contractors, etc. ; besides which it allows the foremen to get their instructions for the day, and you have a clearer mind, and are undisturbed by the thought that you are wanted elsewhere. Another reason is that any slackness or waste of time on the foremen or workmen's part is more likely to occur then than later in the day.

Never force a man upon an unwilling foreman. You are often asked, mostly by soft-hearted clergymen, to give some poor weak soul a chance. As a rule, resist the appeal. There are, and should be exceptions, but as a rule you will find it labor

*Presidential Address delivered before the Institution of Junior Engineers, Westminster, November 1, 1895.

wasted. Remember the cripples. There are always a dozen or so of easy berths, which should be kept either for the old or maimed; and, even if an able-bodied man gets employment in them, he should at once be removed if a cripple comes along. Of course, I mean your own cripples; don't saddle yourself with other people's.

An important question is the amount of interference you should allow yourself between foremen and workmen. Theoretically there should be none, practically it should be the minimum possible, otherwise your time will be entirely taken up in perpetually listening to two sides of stupid differences. At the same time, you should reserve the absolute power of dismissal or employment, always, however, through the foreman; and, further, your ear should be open to any well-founded complaint of injustice on the part of a foreman to a man. If you are careful in the first two or three cases to dispense absolute justice you will be little troubled later, because both foremen and men will be watchful of what they do. Keep in view the possibility of nepotism in foremen, and you must be quick to stamp it out; it is most detrimental to discipline. In both these cases you will observe that, to manage properly, you must have an intimate knowledge of your men.

In case of any man doing a piece of meritorious work, you will find it a good thing to take personal notice of it. It is the right thing to do, and encourages the man. I have often seen cases where a kind word, some tobacco, or a few cigars, given on the spur of the moment, have been more appreciated than a money gift. You should take a personal interest in your apprentices, they are your future workmen; encourage them to continue their education in every way possible at evening classes; the better educated they are, and the more they are on a par with yourself, the more easy it is to get on with men.

MINING IN QUEBEC.

The production of chromic iron in the Eastern Townships shows a marked increase over the previous year, when for the twelve months 915 tons were shipped. Up to the 15th September last there were shipped via Quebec Central Railway:

To Philadelphia	938	tons
" Baltimore	600	"
" Pittsburg	498	"
" England	440	"
Total for 8½ months	2,476	"

of an estimated value of from $35,000 to $40,000, delivered at the Quebec Central Ry. About 70 persons employed.

In his report to the Hon. the Commissioner of Crown Lands, Mr. J. Obalski, Mining Inspector for the Province, gives information of value respecting the various industries, from which we have excerpted the following:

The Lambly mine, from which the first pocket worked yielded 600 tons of chromic iron, containing over 50 per cent, has been worked successfully and another deposit has yielded up to September about 800 tons. The total yield has thus been about 1400 tons, working a force of fifteen men, 1200 tons of which were shipped. The deposit now being worked is in the form of a vein running north for a distance of from 200 to 300 feet, and appears to dip 45° west, with variable depths, reaching as far as 9 ft., but the present thickness is less.

The total output of the Jobodin mine is estimated by Mr. Obalski at 172 tons.

The Hall mine, operated by G. B. Hall, of Quebec, was opened in July. A good deposit was discovered and 75 tons taken out, a carload of which was shipped.

The Lake Caribou Mining Co. working near Lake Caribou produced about 400 tons.

The output of the Blondeau and Roberge mine was about 200 tons, 120 tons of which were shipped.

The Dumais mine, worked last winter, resumed mining in the spring and the output is placed at 160 tons, 125 of which were shipped.

The output from the Frechette mine was about 100 tons, shipments being made from Black Lake station.

From the Lemieux property, about 70 tons were won from two small excavations. The ore here appears in the form of veins, the first a solid one from one to two feet in thickness, and the other running north for about a hundred feet with a thickness varying from one to four feet.

The Lemelin mine was worked regularly from July, 1894, up to the end of August last, yielding about 430 tons, 300 tons of which were shipped. The ore contains a fairly high percentage. It has been followed in a north-easterly direction by a cut 200 feet long and from 25 to 30 feet high at its extremity. The thickness of the deposit varies, being as much as four feet.

The Anglo-Canadian Asbestos Co. has taken out about 70 tons of chromic ore in the south-western part of its territory. The indications are reported to be sufficiently good to justify more extensive work. The mineral is of good quality.

From the Leonard & Morin mine the output is reported to be 1,100 tons, of which 600 tons were shipped. This output was taken altogether from surface. This property will be worked during the winter.

The Topping mine yielded about 50 tons, two carloads being shipped.

Work on the Nayes property has been resumed and about 35 tons of high grade being taken out.

In the Township of Garthby a certain amount of mining has also been done, the Leonard mine yielding 300 tons of high grade ore and the shipments amounting to 236 tons.

With respect to asbestos mining Mr. Obalski has the following to say:— "The demand for asbestos is fairly steady but prices continue low, so that work was carried on only to meet demands. However this industry seems to be entering upon a new phase if we may judge by the two very large mills erected by the Bell's Asbestos Company and the Danville Asbestos and Slate Company for the purpose of extracting from the Serpentine all the small fibres which were thrown away and were considered useless. This product it seems will be used in making paper and there is no doubt that if the price is remunerative, and the demand sufficient, this industry may become an important one. Last year (1894), 8,091 tons were shipped, making a good season; it is probable that the quantity will be about the same this year, although up to now there have been fewer shipments. Last winter only the Bell's Asbestos Company and the Danville Asbestos and Slate Company worked, but in the spring, work was resumed at Thetford by King Brothers and the Johnson's Company, and at Black Lake by the Anglo-Canadian Asbestos Company, the United Asbestos Company, the American Asbestos Company, and Dr. Reed, with 400 men at Thetford and 150 at Black Lake. In the month of August last, the Broughton mine belonging to the Glasgow and Montreal Asbestos Company was re-opened by the United Asbestos Company with a dozen men.

"Last winter the Bell's Asbestos Company built a mill at Thetford for the mechanical separation of the fibres of asbestos and the finest fibres were utilized. The treatment consists in breaking up the rock with a Gates breaker; the rock is then run through two rollers and afterwards on endless picking tables where women and children pick out the longest fibres. The conveying from one story to another is effected by elevators. What remains on the picking tables then goes into a cyclone pulverizer which sends the fibres, well separated, to the upper story and they then pass over shaking screens from which a fan drives the final product into a room, where it is put in bags. The apparatus is driven by a Laurie steam engine; the mill has been in operation since the summer. It is lighted by electricity and runs night and day.

"At Danville the Jeffrey mine was worked up to the first of July of this year by the Danville Slate Company. From that date the Danville Asbestos and Slate Company, Limited, took possession while still continuing to get out slate and is carrying on operations on a large scale. The capital of the company is $250,000, its head office is at Danville, and it now employs about 400 men, 225 of whom are working at the asbestos mine, 75 in the slate quarry, 75 at the new buildings and 25 at a small saw-mill and experimental mill for asbestos. They are about to build a mill at the mine with a large capacity for extracting the finest fibres from the rock, as experiments have shown that the debris contains a considerable proportion of fibres and that some parts of the serpentine itself are very fibrous. The mill is a large frame building with stone foundations 160 feet by 60. The process of mechanical separation will consist in breaking and crushing the rock which will then be drawn by hand to endless tables for the purpose of removing the long fibres; the product will then ho taken into a continuous cylindrical dryer and passed through a cyclone pulverizer and finally separated from the last vestiges of rock by screening and fanning, the finished product being collected in receiving rooms. The building is three stories high and the materials will be transported by elevators. The plant consists of a Blake crusher, 36" × 24", with an opening of 7" to 8" in the upper story, another duplex one lower down 40" × 10" with an opening of 2½" to 3" and finally one of 46" × 6" with an opening of 1" to ½", of picking tables, elevators, a continuous cylindrical dryer, 6 cyclone pulverizers and fans which will drive the final product into a separate building consisting of 4 receiving rooms which will be filled and emptied alternately.

The whole of the machinery will be driven by a double Laurie engine of 550 horse power fed by four tubular boilers. The engine and boilers occupy an annex separate from the main building and from the receiving rooms, the store rooms and a water tank. The largest breaker is said to have a capacity of 250 tons per 10 hours. The building of the mill was commenced in June this year and it is expected to be finished in October and in operation for the winter at the rate of one hundred tons a day. Work will be carried on day and night and the mill will be lighted by electricity. In addition to the ordinary qualities of crude asbestos, there will be three qualities of asbestos obtained from the mill; the finest, which will be the most plentiful, will be used for making paper. The company hopes to get a very great yield of fibres. Experiments were made this year with a smaller mill driven by water power and are said to have been satisfactory. There are 225 men employed in the mines including the cobbers, and in order that the yield of the mines may supply the demands of the mill, new machinery will have to be put in and the boom derricks will have to be replaced by travelling or cable derricks.

The same company also works the slate quarry situate one mile from the mill and which employs 75 men including those employed in splitting and preparing the slate at the mill. Roofing slate is prepared as well as school slates and slates for various purposes, the capacity of the mill representing an annual value of $40,000 of products. The mine and quarry are at a distance of from three to four miles from Danville station on the Grand Trunk Railway and the transport costs from 50 to 80 cents per ton. In view of the increased production, the company intends shortly to build a small electric railway for the mine, the quarries and the mills. Alterations and improvements will also be made to the slate quarry. In connection with the new treatment of fine fibres I may say that similar experiments were made some years ago, but on a smaller scale, on the serpentine in the Templeton mines.

In the Ottawa district, I visited an asbestos mine on lot I.42 of Denholm. Last year that mine was worked by the International Mining and Manufacturing Company of Newark, N.J. This year the property is in the name of the Asbestos Mining and Manufacturing Company represented by Mr. N. J. Smith. The mine was worked the whole of last summer and this year 18 men have been employed since May. There are three or four large excavations provided with two horse-derricks. The asbestos is of the variety usually found in the Laurentian serpentines, that is to say, short, the longest barely exceeding five-eighths of an inch, specimens of one inch and over being found only by accident. The company makes two qualities without separating the fibre from the rock, which is shipped to be treated at Newark.

At the date of my visit in June, this mine had yielded 220 tons, a portion of which had been shipped.

Of the Wallingford mica mine in Templeton the Inspector says:— "This mine is now the most important one in the region. The company claim to get out five tons of rough mica a day, corresponding to one ton or one ton and a half of split and thumb trimmed mica. This mine had been worked for two years and was said to have yielded 500 tons of mica. The quality is amber mica, generally of large dimensions; it is at once put in barrels after being first thumb-trimmed. There were in store a good many pieces which sized 4″ × 6″ and 4″ × 7″ and also 10″ × 12″ and over. The largest piece I measured can give sheets 14″ × 18″. The work consisted in a deep pit 150 feet long and 100 feet deep with a width of from 9 to 12 feet running in a W. E. direction. Towards the east the work was a tunnel but they were about to cut down the upper part which was rich in mica. The deposit affected the form of a vein dipping vertically and containing, with the mica, calcite, pyroxene and phosphate, the mica being remarkably abundant."

GOLD MINING IN ONTARIO.

(From our Correspondent at La Seine, Ont.)

The past fifteen days were conspicuous for the reappearance of many of our pioneer prospectors and capitalists, as well as the advent of some new, and decidedly energetic business men. Mining, consequently, has received a great impetus, and as winter approaches the rush is general along the margin of La Seine River and the Manitou Lakes, to get in supplies and complete examinations and other necessary preliminary surface work.

Foremost among the pioneers come Colonel Ray, who after completing a thorough examination of the adjacent interests of "Wiegand," acquired by purchase complete control of the balance of what is currently regarded as the most attractive group of claims in the protegin belt—a particular mention of which appeared in October issue.

Meantime Mr. Ferguson, M. E. of London, England, has not been idle. His miners are now en route from Tower Minn, while a force of carpenters are rapidly putting the finishing touches upon their winter quarters.

At the Foley Mine, A. L., 74, 5 and 6, sinking in two shafts, with rock drills, goes on unceasingly and with the same satisfactory results—the value of the ore on their dumps being of such high grade as to warrant the utmost vigilance of the company's officers. Visitors are now present between La Seine and the Manitou from various western cities and mining centres between San Francisco, Denver, Texas and Washington Territory, and all are apparently favorably impressed with our prospects. Already the important question of the establishment of a customs reduction works for this immediate section is being considered by visitors of reputed experience, who believe, even at this early stage of development, that the output of ore from a given group of claims, in this section, would, if vigorously opened up, pay handsomely for the venture of a large reduction works.

Capital, however, notwithstanding the fine showing of native and free milling gold ores is, I repeat, deliberately slow in taking hold; and in this respect—as in other essential ones,—our case is very similar to that, which for several years prevailed around Johannesburg and the Transvaal generally. But all things come, etc., even our mails. Thanks, however, to the much superior mail service of the United States, we shall be enabled to avail ourselves of these facilities (two mails per week for winter) by sending (paying) a special courier from here to Fort Francis (some 40 miles), that is, if we cannot await the regular (?) bi-monthly dog train via Lake of the Woods.

Meantime, by sending communications for La Seine River via Koochiching, Minn., it makes a difference of eight mails instead of two in our favor, which, in the absence of telegraphic connection, is a most important advantage, and one that even our ordinary workmen here fully appreciate, as evidenced in a voluntary contribution in aid of our very limited government allowance.

Mining development upon the "Foley claim," A L 74, 5, and 6—under bond from Colonel Ray—goes on with the most encouraging results. They are now down to a depth of 95 feet in both shafts, and the veins again opening out to their usual dimensions of 2 and 3 feet 6 inches respectively. The bond or option of purchase referred to expires early in January next, when it is anticipated that important changes will occur at this very interesting mine.

The "Bill Wiegand's claims," consisting of A L 103, 4, 5 and 6, all partially developed—at least superficially—are still attracting considerable attention from local and outside capitalists. Already many propositions have been made the owners, W. Wiegand *et al.* Their lots are traversed by the same series of fissure lodes as at the Ray and Foley group, and as the conditions are also identical with the foregoing, now under active development, the eyes of the would-be mining and investing visitors (as well as owners) are centered upon the A L 76–7. Already and presumably in anticiparion of a continuance of bonanza ore, prices of immediately surrounding claims have gone up.

The Bull Claims, consisting of 669 P, J O 12, 13, 14, 15, S 22, and P 317, all of 40 acres each, are now attracting attention. The first four lots are being partially developed, and all are traversed by a series of three fairly well defined quartz veins, that carry, in many places tested by sinking, a very appreciable quantity of coarse and fine gold, visible to the naked eye, while upon at least two of these claims the showing of native gold is very fine indeed. This estate is now being examined in the interests of foreign capitalists. It is, however—unfortunately for its owners—situated upon the unsettled (so-called) "timber herth," where "several millions of valuable pine, etc.," (?) was said to be in danger of fire from the dreaded invasion of the gold-hunter, etc., but whereon—as a matter of cold, and for the owners of this timber, unpalatable, fact—the original estimates by wire (and wool) pullers were seriously overdrawn; in consequence of which sweeping reductions are now being made in the choppers sent in there to clear off this timber, for the purpose of making the work "spin out" for all winter, and probably all summer too. Consequently there is no probability of deeds or leases being issued by the Ontario Government.

The Ottawa Prospecting Co., with several promising claims, remain inactive *pro tem.*

The Ferguson Developing Co., embracing A L 110 and 11, the Kilby Alisher lots, and at least one of the Wilson-Bartley lots adjacent to "Bill Wiegand's," have let another contract from 50 to 100 feet in both shifts, drilling and hoisting by hand and horse power. This is the property honded to Mr. Ferguson, of London, Eng. This is also contract work. Like the Ray-Foley's, the Ferguson lodes are fissures and in the protogine, at or near the intersection or merging of the granites with the gabbro. Mr. W. D. Ferguson, now in London, is due here early in January next.

COMPANIES.

Lillooet, Fraser River and Cariboo Gold Fields, Ltd.—The directors have issued a circular to the shareholders giving information as to the properties recently acquired. These include three miles of the old bed of the Cayoosc creek; a property overhanging Cayoose creek covering an area equal to 525 claims in the Transvaal, in connection with which arrangements are being made to erect a thirty-stamp mill; and a property known as the Abbott group, situated in the Lardeau district, covering an area equivalent to 187½ claims in the Transvaal.

Hall Mines, Ltd.—The directors have issued the following circular to the shareholders:—The directors have now much pleasure in being able to inform the shareholders that the wire tramway from the mine to the smelting works at Nelson has been completed, and is in operation, bringing down ore to the bins at the rate of ten tons per hour. The buildings at the smelting works also are now approaching completion, and the smelter is expected to be in operation towards the end of the year. Water from the creek close at hand will be supplied to the works. The smelter will have a capacity to smelt 100 tons of ore per day, and the lines of the Canadian Pacific Railway Company will run directly into the works. Development work at the mine has also been making good progress, and the existence of the ore-body to the depth of upwards of 400 feet from the surface has been proved by boring. It will also be satisfactory to the shareholders to learn that the chairman of the company is now at Nelson, inspecting and pushing forward the works, and that he hopes to remain there until the smelting works are in full operation. On his return to this country, early next year, the directors will be able to place before the shareholders his full report for their information.

Islander Gold Quartz Mining and Milling Co., Ltd., was registered at Victoria, B.C., with an authorized capital of $100,000 in shares of $1, for the purpose of taking over and working the Islander mineral claim, situated on a branch of Granite creek, Alberni district, Vancouver Island, B.C., and for the purpose of purchasing and working such other mineral claims as the company may determine.

Returns from assays made of the surface ore have varied from $2 to $15 per ton in gold and copper. The character of the ore is similar to those produced by the Le Roi and other mines at Trail Creek in West Kootenay. It is believed that as depth is attained the value of the ore will greatly increase, as was the case with the Trail Creek ores. Assays have been made by Price, of San Francisco; Tacoma Smelting and Refining Co., Tacoma; W. Pellew-Harvey, Vancouver; Government Assay Office, Victoria. Only surface work has, so far, been done on the ledge, which is from four to eight feet in width. It is proposed to sink shafts and otherwise prospect the mine, so as to thoroughly prove its extent and value. Directors: John Irving, M.P.P., Victoria, B.C.; Wm. Munsie, Victoria, B.C.; W. G. Mackenzie, Victoria, B.C.; Thos. H. Prosser, 18 Broad street, Victoria, B.C., Secretary.

Tilt Cove Copper Company, Ltd.—The seventh ordinary general meeting of shareholders in the Tilt Cove Copper Company, Ltd., was held last month at the office, 6 Queen Street Place, London, the chair being occupied by Mr. J. R. Francis.

The Secretary (Mr. E. C. Leaver) read the notice convening the meeting.

The Chairman called upon Mr. J. C. Leaver to make a statement regarding the company's position.

Mr. J. C. Leaver said: Gentlemen—The Chairman desires me to say that these accounts only bring us up to August 31, 1894. As a matter of fact this concern, as you know, is being carried on by the Cape Copper Company, and in the course of a few weeks they will issue their report which will include an account of the working of this company up to August 31, 1895; so that, practically, our present accounts are not of much interest. Beyond this I have really nothing to say, but we can promise you that the accounts, which will be presented to you shortly, will be very much bètter than those now before you. How much better they will be I must not say, because they are now being compiled for audit by the Cape Copper Company. This is merely a formal meeting, held in compliance with the statute.

A shareholder asked if the accounts to be submitted shortly would not show a material improvement owing to the rise in copper.

Mr. Leaver: We quite hope that our next accounts will show a very much better state of affairs, but I shall be telling you the Cape Copper Company's business if I say more. We consider that with the present price of copper we are in a much improved position. Our losses have stopped.

On the motion of the Chairman, seconded by Mr. John Taylor, the report and accounts were adopted.

On the motion of the Chairman, seconded by Mr. Sexton, Mr. J. C. Leaver and Mr. John Taylor were re-elected as members of the committee of management.

The auditor, Mr. William Barclay Peat, having been re-appointed, the proceedings terminated in the usual manner.

Canada Iron Furnace Company, Ltd.—The Hon. E. J. Flynn, Commissioner of Crown Lands, has given notice in the Quebec Legislature of the following resolutions respecting this Company:—Resolved (1) That the Canada Iron Furnace Company, a body corporate and politic, incorporated by Dominion Letters Patent, with its head office in the city of Montreal, and its works at Radnor, in the district of Three Rivers, shall be recognized as a colonization society within the meaning of section 10, of chapter 7 of title fourth of the Revised Statutes, (Articles 1725, and following). Resolved (2), That it shall be lawful for the Commissioner of Crown Lands, with the approval of the Lieutenant-Governor in Council, on a requisition on behalf of the said company for lands for the settlers whom it is desirous of establishing from time to time, to assign, as provided in Article 1734 of the said Revised Statutes, to the said company, a township or part of a township for its operations. Resolved (3), That in no case shall a township or part of a township be thus reserved for more than ten years.

Northumberland Stone Co., Ltd.—This company is applying for incorporation with an authorized capital of $10,000, in shares of $10.00, to carry on the business of quarrymen in New Brunswick. The directors are: James Frier, B. B. Tweed, W

C. Milner, Napoleon Leblanc and Foster Packard. The business is to be carried on in the village of Shediac, Westmoreland County, N.B.

Caledonia Consolidated Mining Co. has been registered with headquarters at Spokane, Wash., and a capital of $500,000 to carry on mining in British Columbia.

Dixie Mining and Milling Co., Ltd., has been registered with headquarters at Spokane and an authorized capital of $500,000, to carry on mining in British Columbia.

Homestead Gold Mining Co., Ltd., has been formed to take over the property and assets of the Homestake Gold Mining Co. of Spokane. Authorized capital, $500,000. Head office: Vancouver, B.C. Directors: Thomas Dunn, J. E. W. Macfarlane, and Ernest E. Evans.

Wolf Hill Mines Co., Ltd., has been formed in British Columbia to purchase certain mineral claims on Wolf Creek, in the district of Sooke, known as the "War Horse" and "Empress," for the sum of $25,000, to be paid for in fully paid shares of the company, and for carrying on the business of miners. Authorized capital, $100,000, in shares of $10.00. Head office: Victoria, B.C. Directors: James Dunsmuir, William Ralph, Theodore Lubbe, and C. E. Pooley, all of Victoria, B.C.

O. K. Gold Mining Co., Ltd., has been registered under the Foreign Companies' Acts, with an authorized capital of $1,000,000, to carry on mining in British Columbia.

The Delta Mining and Development Co., Ltd., is being incorporated in British Columbia to acquire the mineral claims on Lulu Island and recorded as "The Setting Sun," "The Gladys," "The Diablo" and "The Valkyrie," and to pay for the same in fully paid up shares of the company. Authorized capital, $100,000. Head office: Vancouver. Directors: John Clark, A. C. McArthur, and J. W. Jackson.

The Silver Key Mining Co., Ltd., is being incorporated in British Columbia with an authorized capital of $100,000, and headquarters at New Denver, West Kootenay, B.C. Directors: Cornelius M. Getting, James Gilhooly, and George D. Long.

Gabriola Coal Co., Ltd., is being incorporated in British Columbia to acquire coal lands and to carry on the business of miners. Authorized capital, $1,000,000, in shares of $10. Head office: Nanaimo, B.C. Directors: Marcus Wolfe, A. E. Rand, A. J. Hill, Elijah Priest, and W. W. B. McInnes.

North Saanich Coal Co., Ltd., is being incorporated in British Columbia, with an authorized capital of $25,000, in shares of $10. Head office: Victoria. B. C. Directors: T. W. Paterson, Wm. Templeman, and E. B. Marvin.

Golden Group Mining Co., Ltd., is applying for incorporation in Nova Scotia to carry on mining in that province. Authorized capital, $100,000. Directors: A. A. Hayward, Waverley, N.S.; F. S. Andrews, South Essex, Mass.; H. H. Bell, of Halifax. Head office: Halifax.

Colliery Managers.*

By Mr. M. Walton Brown.

The colliery manager of the present, and more especially of the future, must be a man of education, and, as time advances, the requirements of his profession will become more and more exigent. A colliery manager cannot accept theories which he does not understand; his education must be exact and thorough, otherwise he will be classed as a workman, and not as a professional man. The management of mines must be more efficient in the future than it has been in the past, and the individual must become part of the profession.

The objects of the National Association of Colliery Managers are to improve the social, scientific and intellectual position of the colliery manager; to support and protect their character, status and interests . . . ; to originate and promote improvements in the law . . . and in administration . . . ; to defend individual members . . . and to assist members to obtain employment.

The status of the profession of a colliery manager can be improved by intercourse between members, so that he may know the capabilities of others, and be known to others, and thus render the work of one the work of the profession.

The publication of professional papers is an essential object of the association, and they become the tools to be used in the management of mines. Papers only begin to be useful after they are read to the members; they induce discussion, and in this manner increase the common knowledge of the members.

The papers appearing in the *Transactions* are good, and, although creditable to the authors, they do not appear to induce that full discussion which would prove invaluable to the members. Suggestions have been made from time to time that prizes should be given for the best paper communicated during each year; but would it not be more desirable to give a prize to the writer of the paper which produced the best discussion of the year?

The elevation of the status of the members is the essential feature of the association. It should ensure that the members do the very best work in their profession; it should teach them that they are fellow-workers, and produce a profession culture until it becomes impossible for any member of the association to be an inefficient colliery manager.

The association must, however, promote the interest of the profession rather than that of the individual, and strive for the advancement of theoretical and practical skill and the maintenance of high professional position. The affairs of the individual must be left untouched; it must not impose scales of payment, otherwise it would become a trade union. The status of the colliery manager can only be improved by the individual being merged in the profession, and not by agreement to restrict the right of the individual to receive payments in accordance with his skill. Each member should endeavor to add to the knowledge of his fellow colliery managers by recording the results of his experience for their information, and in return he will learn from their keen, but friendly, criticism. At the meetings the members benefit by personal contact with fellow managers and from the mutual exchange of experiences and of suggestions as to modes of overcoming difficulties met with in their daily duties.

Although vast strides are now being made in this country by the provision of numerous opportunities and facilities for the technical training of colliery managers, this development cannot be allowed to stand still, but must keep pace with that of the best practice of the profession, otherwise mining education will become a study of ancient history, and of no advantage to the student as aids in overcoming the technical difficulties of his work.

The education of a colliery manager is necessarily very comprehensive. As a schoolboy he should acquire a knowledge of several modern languages, in order that he may hereafter be able to read the valuable works on mining published in other countries; and if he can also acquire a little Latin and Greek, it will certainly prove useful to him in his profession.

A knowledge of mathematics and the physical sciences is essential in utilizing the forces of nature and directing them to the service of mankind. He should, therefore, acquire a knowledge of geology, physics, chemistry, and every science appertaining to his profession. He need not endeavor to acquire more than the general principles of these sciences, so that he may know where to find detailed information when required, and to follow the present rapid development of knowledge in all its branches.

A colliery manager is required to apply machinery to multitudinous purposes. He should have a knowledge of the nature and strengths of building materials, so as to utilize both material and labor in the most efficient manner.

Geology is the essential study of a colliery manager, being utilized in directing the search for minerals, and the miner has often assisted the conclusions of the geologist. Water supply and surface drainage are now becoming prominent questions for satisfactory solution.

Heat is studied in relation to the efficiency of steam and other heat engines. Cold is used for the freezing of water-bearing rocks. Compressed air is used for working pumping, coal-cutting, rock-drills, and other machinery. Coal is distilled for the production of coke and lighting-gas, and the bye-products should all be utilized. Electricity is used as a source of light, for the working of fans, pumps, and other machinery, for the ignition of explosives, for signalling, and many other purposes. High explosives are likely to play an important part in coal mining of the future. The prevention of smoke still awaits the invention of an efficient remedy. Variations of temperature and pressure of the atmosphere may give warnings of possible issues of gas in mines. Calculating machines, such as the slide-rule, the planimeter, etc., lighten the labor of calculation.

The preceding remarks only convey a slight notion of the aids afforded by the sciences to the colliery manager. The colliery manager should especially study mankind, political economy, and statistics, so that he may be able to decide upon the commercial advantages of any mining enterprise, and to secure the confidence of those who may have to base their decisions upon the results of his plans and estimates. He should be competent to draft the details of the necessary works, the capital required for their execution, the costs of working, and to substantiate his views before unfriendly critics.

Although this is an age of immense enterprises, attention should be given to every small matter of detail, which possibly form the elements of successful management.

To a large extent, the success of a colliery manager depends upon his tact, his powers of speech and genial manners. The writing of papers provokes accuracy of thought and clear description, but it is more important to be able to make extemporaneous speeches; and members should attend every meeting and take part in the discussions, even if they have nothing new to bring forward.

The practical colliery manager affects to despise technical training and all scientific results or theory; but he constantly, consciously or unconsciously, applies theory to all the items of his daily duties. Theory is merely the expression of the results of experience made available for application under similar conditions, and, however practical a colliery manager may be, reason leads him to form opinions or theories, based upon the results of his actual past experience. It is certain that the success of the "practical" manager is dependent as much upon the application of scientific theories as that of the manager who may have received a scientific training and served a term as an apprentice to his profession.

The old-fashioned colliery manager achieved successful results by sound common sense, shrewdness in acquiring knowledge, and from his capacity to manage workmen and to select qualified assistants. These qualifications are still essential to the successful management of collieries, accompanied with scientific knowledge based upon youthful training in mathematics and the physical sciences.

* Presidential address delivered before the North of England Branch of the National Association of Colliery Managers.

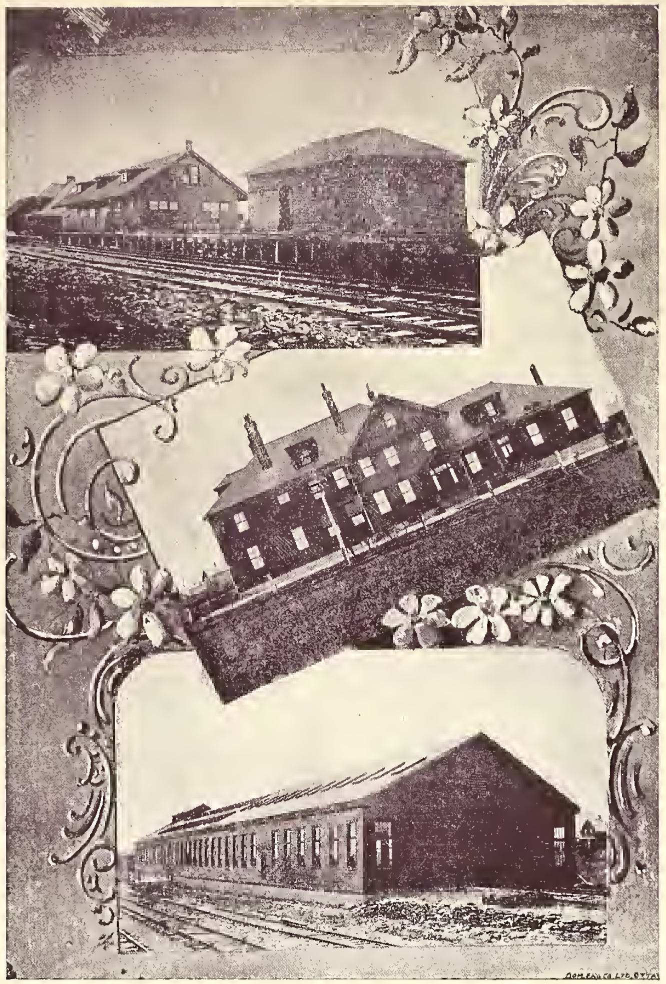
The Training of a Mining Engineer.*

By Professor Henry Louis.

Physics, again, not only teach the student the laws that govern the motion of matter, but is every day becoming of greater practical importance. Electricity, especially, has been playing a most important part in mine engineering; I need only mention electric coal cutting, electric underground and surface haulage, and the electric transmission of power, to remind you of the number of applications that this science has found of recent years; and indications are not wanting that further developments of this force will be produced before long that will almost revolutionize some aspects of mining. There seems little doubt that we shall have to look to electricity in the near future to provide us with a really perfect form of safety lamp, and that if even explosions in coal mines are to become a thing of the past it will be through the agency of the electric light. It may indeed be said that there seems scarcely any limit to the potential application underground of this most convenient force. I hold, therefore, that besides theoretical physics, a mining engineer's training should include a short time in an electrical laboratory or shop, where the student may be familiarized with the construction of electrical machinery and the application and measurement of electric currents. Of the importance of mechanics little need be said; such subjects as machine construction, strength of materials, the steam-engine, water-motors, and many others, come so obviously into the every-day practice of the mining engineer that he must perforce study their principles thoroughly.

A mining engineer is so often called upon to design machines for various purposes, or to test the efficiency of a machine already constructed, that he must be a good mechanic. I hold that it is not necessary for him to actually serve any time is work-

* Inaugural Address delivered at the Durham College of Science, October 17, 1895.



Dominion Coal Co.—Warehouse at Glace Bay, C.B., New General Offices, New Machine Shops.

New Trestle to convey Dumping Material over the Quebec Central Railway recently completed at King Bros. Asbestos Mines, Thetford, Q.

of Colliery Managers.

* Inaugural Address delivered at the Durham College of Science, October 17, 1895.

shops, although he will often find it an immense advantage to be able to use some of the simpler engineers' tools, and more especially to do a little smithing. In out-of-the-way corners of the world I have found the ability to sharpen a drill or to point a pick of greater value to me than might be supposed by those who have never prospected in remote regions.

These three sciences—chemistry, physics and mechanics, together with the all-pervading mathematics—form the basis of the mining engineer's training. Next come what may be called secondary sciences, more closely connected with the miner's special work. These are geology and mineralogy. Geology is, to a great extent, the scientific basis of mining; the man whose daily duty is to exploit certain portions of the earth's crust must know thoroughly the rocks of which it is composed, their appearance, their composition and the mode in which they were formed. He must not only know geology thoroughly, but must also have some knowledge of the subjects most closely connected with it. For instance, he must know something of paleontology. Evidently, the more he knows the better; but a fair general knowledge, without entering into recondite details, is all he needs. Thus he ought to be able to recognize a tribolite when he sees one, and to know that if he comes across strata containing these fossils he need not waste money in sinking deeper in search of coal beds. This knowledge is quite enough for practical purposes, and he would not be any better off, practically, for being able to name the genus and species to which the tribolite might belong.

Similarly as regards lithology; this science, in its ultimate development, is best left to specialists. All a mining engineer really requires is to tell broadly what class of work he is dealing with. It does not matter much to him, as a rule, whether a certain rock that he might come across is (say) a diorite or a diabase, provided that he knows, beyond the possibility of mistake, that he is not dealing with a stratified rock, and what the effect of a dyke of igneous rock is likely to be upon the strata which it traverses. In fact, for the mining engineer physical geology is the most important part of the subject, and one which he must have at his fingers' ends. It is, perhaps, needless to say that geology must be studied in the field no less than in the lecture room, and that the mining engineer ought to be familiar with all the various indications by which geological phenomena can be recognized and traced.

Mineralogy, including crystallography, deserves more attention than is usually devoted to it. The ability to be able to recognize at once any mineral that he comes across is of immense use to the mining engineer, and in this he is always greatly assisted by crystallographic indications. I may quote a case in point. I was once sent to report in a great hurry upon a deposit of magnetite in Nova Scotia that was offered for sale as a Bessemer ore. I found, on examining the ore, that it contained minute needle-like crystals, which, under the lens, appeared as hexagonal prisms, and which, from their crystallographic characters, I concluded to be a mineral called apatite, consisting of phosphate of lime. I accordingly broke off the negotiations at once, and subsequent analysis confirmed the correctness of my diagnosis. Here, then, was an instance in which a knowledge of crystallography saved much time and, possibly, a heavy pecuniary loss. Another instance that came under my cognizance was that of an engineer who had to report on a silver lead mine. He took his samples from various points along the levels, and as his assays gave very satisfactory results, he was preparing to report favorably when a close examination of some crystals of galena that he had broken out from the roof of a level showed Portland cement on the back of the specimens. Needless to say, this discovery was enough to show him that the mine had been "salted." These two examples will, I hope, suffice to show how the knowledge of what is really a pure science can have a very practical value, even in the commercial sense, for a mining engineer.

We now come to the course on mining proper, to which the previous subjects serve as foundation, so to speak. I have not attempted, and in a college like this, with a staff of professors whose duty it is to teach these sciences, and whose eminence in their respective subjects is too widely acknowledged to need any word from me, I would not venture to do more than indicate what bearing these sciences have upon the training of a mining engineer, and to what extent he needs their aid. The first part of a mining course usually consists of what is, strictly speaking, a portion of geology—namely, an account of the various forms in which mineral deposits are met with, the mode in which these deposits have been formed, and the various classes of dislocations and interruptions to which they are subject. These matters need dwelling on in more detail than is usually possible in a course of geological lectures; indeed, in some continental universities these subjects are elevated to the rank of a separate science, and professional chairs have been devoted to it. The student has next to attack mining proper, and here he comes at once into a new world. He has hitherto been studying pure science; now he has to learn an art, and must from the first be taught to consider it in its trade aspects. All such subjects as prospecting, boring, shaft sinking, exploitation, haulage, winding, pumping, ventilation, and so on, have to be considered in their economic, as well as in their technical, aspects. Of course, it is absolutely impossible to learn mining either from lectures or from books alone. Not very long ago I saw in a newspaper an advertisement from someone who proposed to teach mining by correspondence, and I could not help wondering how a mine would fare, the manager of which had been taught in this fashion. All that a lecturer on mining can do is to describe to his students the practice in various parts of the world, and the principles upon which it is based, drawing especial attention to those methods that have proved economically successful, and also whenever possible contrasting with them other systems that have proved failures or have been superseded by better ones. After all is said and done, mining must perforce be learnt in the mine. A combination of practical work with lectures is the best way of learning, but then it is always preferable, whenever possible, that elementary lectures should precede the practical work, so that the student may know what to observe and how to observe it. After he has learnt all the pure science he needs, let him attend a course on elementary mining, and not till then let him go underground. Advanced lectures of a more specialized nature should then be attended, say, during two days a week, while the student is working in the mine for the rest of his time. Furthermore, there should be special short courses on such matters as mine accounts, mineral legislation and mineral statistics. Mine surveying should be thoroughly taught in a course of demonstrations, in which the students themselves are made to execute surveys, if possible, underground, or, if not, at any rate, under somewhat analogous conditions. They should be taught to calculate and plot their own surveys, and especial attention should be directed to the calculation of quantities upon a systematic basis.

A branch of mining that requires special training is that of ore dressing, in which term is included all the mechanical preparation of minerals after they have been brought to bank in order to fit them for the market. All methods of crushing minerals and of dressing them, whether the object of the process is to save the heavier portions as in lead dressing, or the lighter ones as in coal washing, are also included. This subject is best taught by laboratory demonstrations. A laboratory for this purpose should be filled with various types of crushing machines, and with experimental jigs, shaking tables, &c., so that the student can test for himself the effect of various processes and of various ways of carrying out the same process upon a given ore; there should also be facilities for assaying the products of the operations, so that the student can prove to his own satisfaction the value of his work. Properly conducted, such a laboratory course has immense educational value, in addition to the training it affords in the treatment of minerals, and a student who has gone through such a course will have a grip of his subject and an intimate knowledge of minerals, such as no amount of mere lectures or reading can give him. I am, accordingly, inclined to lay especial stress upon the importance of a course of practical ore dressing.

Finally, the mining engineer must have a good general knowledge of metallurgy. It is no exaggeration to say that nine-tenths of all the products of mines, whether coal or metalliferous, are intended to undergo metallurgical treatment. In fact, minerals are mined and prepared for that object. Unless the mining engineer knows exactly what the processes are by which the mineral he raises will have to be treated, he is not in a good position to judge of the most suitable condition in which they should be delivered, and without such knowledge he is likely to produce an article less readily marketable than the man who knows what after-treatment he is preparing his ores for. Obviously, therefore, the man who knows metallurgy is likely to get better prices for his products than the man who does not. In addition, the study of metallurgy completes and rounds off his knowledge of minerals, and thus puts a finish on his technical education. The minor details of metallurgy are not, indeed, required, but a general knowledge is, and no man can be considered a really thorough mining engineer unless he is a metallurgist as well.

I have now laid before you, briefly, the main elements that should, in my opinion, compose the technical training of a mining engineer, and I venture to think that a man thus trained is in a position to take his place in a mine, and to be of some use from the day he enters it, although, of course, he will have to spend a good many years underground before he can attain to any mastery over his subject. It may be objected that such a training as I have sketched out will require a good deal of time. So it will. I do not consider five years any too much to devote to the study of mining engineering. I do not know of any profession that can really be learnt in less, and hold very strong opinions as to the injury inflicted upon the mining industry in every way by the admission into the ranks of mining engineers of men only partly qualified for their duties. Unfortunately, mining is, to some extent, a hazardous career, and chance plays a far largar part in it than in most other pursuits. Hence it may happen that an untrained man now and then finds himself in charge of so good a mine that all his ignorance cannot prevent its paying its way. I remember an instance in South Africa, where a certain mine manager had control of a very successful mine, and for a time enjoyed quite a reputation as a mining authority; yet all this gentleman knew about mining was what he had been able to acquire while following his former occupation of a ship's steward! Such things will occur as long as the duties and training of a mining engineer remain vague and undefined, but it is pretty evident that a clearer public opinion on this point is gradually springing up. One thing is quite certain, and that is that in the face of the keenness of competitian all over the world to-day no mining engineer can afford to neglect any item of training that is likely to help him in the struggle for existence, and that no mine can pay so well, in the long run, as the mine that is controlled by a properly qualified manager.

Do not think that I am taking too candid a view of the mining engineer's duties; the sole justification for his existence is that he can make mining pay, and mining, I repeat, is a purely commercial pursuit. Accordingly, as I have said, the mining engineer must be first and foremost a man of business, and must study science, not for its own sake, but for the profit in pounds, shillings, and pence that he can get out of its application. If any of you are inclined to contrast unfavorably such a purely utilitarian career with the pursuit of science for its own sake, I would ask you to remember that, while the scientist passes his life in adding to the knowledge of mankind, the technican spends his in adding to the stock of human comfort by his labors; and I venture to assert that of the two the latter object is at least as important as the former one.

Ordinary General Meeting of the Mining Society of Nova Scotia.

The Ordinary General meeting of the Mining Society of Nova Scotia was held in the rooms of the Society, Halifax, on Wednesday, the 4th of December. There were present:— R. H. Brown, (General Mining Association) President; W. Blakemore, (Dominion Coal Company, Limited); G. W. Stuart, Truro; Charles Fergie, (Intercolonial Coal Co.) Westville; B. C. Wilson, Waverley; D. W. Robb, (Robb Engineering Co.) Amherst; George Francklyn, Halifax; B. F. Pearson, Halifax; A. A. Hayward, Halifax; C. C. Starr, Halifax; Geoffrey Morrow, Halifax; Doctor Gilpin, Inspector of Mines, Halifax; C. E. Willis, Halifax; Charles Archibald, Halifax; Alexander Dick (Canada Coals and Rail Company), Joggins; W. A. Saunders, Lake Lode, Caribou; F. H. Mason, F.C.S., Halifax; G. Dick, C. & M.E.; Duncan McDonald, Truro; T. R. Gue, Halifax; J. H. Austen, Halifax; W. L. Libbey, Brookfield Queens Co.; Edward T. Jenner, Sherbrooke; Clarence H. Dimock, Windsor; and H. M. Wylde, Halifax.

The proceedings opened at half past ten in the forenoon, the President, Mr. R. H. Brown, in the Chair.

The Minutes of the annual meeting were read and on motion adopted.

New Members.

The following new members were elected:

Mr. Thomas Spry, Mr. C. Rood,
Mr. E. T. Jenner, Mr. D. K. Grant,
G. A. Orrick.

Delegates to the Federated Board.

A communication from Mr. John Blue, President of the General Mining Association of Quebec, asking that the society appoint delegates to the Federated Board for the ensuing year was read.

THE SECRETARY—The constitution gives us one delegate for every forty members or fraction thereof. We will thus have three delegates in addition to the President. We have in the neighborhood of one hundred members.

Mr. Blakemore—Having joined the Federation, we must comply with the regulations, and therefore there is no possible ground for refraining from the necessary procedure in electing representatives, but unless we know definitely the place of meeting I do not see that we are in a position to appoint them. I presume the place will be appointed by the majority of the Board. I take it for granted that delegates will have their expenses paid either from the joint funds or from the funds of each society.

The Secretary—That question has not been raised before. I do not think that our society can bear any such expense. It might possibly come out of the three hundred dollars we pay in. In the previous discussion of federation it was understood that it would not cost us more than three hundred dollars.

Mr. B. C. Wilson—If the delegates have to pay their own expenses we will have to draw lots.

On motion the following were appointed delegates:— Mr. John E. Hardman, Mr. Charles Fergie, and Mr. R. G. Leckie.

The Duty on Mining Machinery.

Mr. W. Blakemore—I would be much obliged if some gentleman would inform me what mining machinery can be brought into the country free of duty.

The President—Machinery of a class or kind not manufactured in Canada.

Mr. Fergie—That test will not always apply.

Mr. Robb—The article must differ in some special way from a like article made in Canada.

Mr. Blakemore—Suppose, for instance, a pump manufactured in England or the United States, and of a different character to one made here, and superior on account of the principle of its construction; it seems to me that should be free, yet I have found that it is not so in practice.

The President—The Worthington pump could be imported at one time but now they make them of the same pattern in Canada.

Mr. Fergie—The customs house people say they will not admit any machinery except actually in connection with the mining of coal. That bars air pipes and lamps. We should get through the medium of this society some expression from the customs house people as to what they will class as mining machinery.

Mr. Libbey—I have been importing shoes and dies of a special make from New York. I made a statement that they were not manufactured in this country and they were admitted free.

Mr. Blakemore moved that the Secretary be requested to communicate with the Secretary of the Federated Board, asking him to communicate with the customs authorities on the subject of the importation of mining machinery and that members furnish him with every possible information on the subject.

Mr. Fergie seconded and the motion passed.

Mr. Blakemore—We have paid duty on ten miles of large size iron pipe.

Mr. Austen—There is another matter in this connection worth noting. We buy iron pipe in the States at a certain discount. We receive certified invoices from the makers and put in an affidavit that these are the actual values. The government, however, compels us to amend our entries and fix a certain discount, more than which they will not allow.

Amendments to the Mines Act.

The following report of the committee appointed to suggest amendments to the Mines Act was then read:—

To the President of the Mining Society of Nova Scotia:

Gentlemen,—At a meeting of the Mining Society held in the rooms in Halifax on Nov. 6th, 1894, the undersigned were appointed a committee for the purpose of securing, if possible, further legislation which might be in harmony with good mining practice and the best interests of this Province.

Your committee decided, after careful consideration, that a full opportunity should be offered all interested in mining to express themselves on the subject, and that they should be invited to give their opinion, not only as touching the legislation which is already on the Statute Book, but with regard to any point or points which it might be desirable to embody in future legislation; and also, as to the most desirable general policy of the Government towards the mining industry as a whole; and suggestions were also asked for regarding any point or points which looked to the prosperity of the mining industry, either particularly or as in whole.

With these objects in view, your committee issued circulars, soliciting suggestions upon the three following groups of subjects:—

1. Amendment to the present Mining Act.
   - (*a*) Of title and tenure.
   - (*b*) Of mining regulations.
   - (*c*) Of special rules.
   - (*d*) Of royalty and rentals.
   - (*e*) Of applications for locations of areas.
   - (*f*) Of forfeiture, etc., etc.
2. As to the general policy of the Government towards the mining industry as a whole.
   - (*a*) Looking to improved facilities.
   - (*b*) Looking to general topographical and geological surveys of the province, and extended information of our mineral resources.
   - (*c*) Looking to extension of markets for the raw products of our mines.
   - (*d*) Looking to the investment of foreign capital in this industry.
   - (*e*) Looking to technical mining education.
3. Generally of a policy which will look to the prosperity of the mining industry, either particularly or as a whole.

In response to this circular the Secretary of the Society has received replies from several members making suggestions on these various points.

The suggestions sent in by most of the writers are devoted to Subject No. 1, relating to the amendment of the present Mining Act, and most of these refer to subsection (*a*) on the question of "Title and tenure." Nearly all of the suggestions sent in on this sub-section refer to gold mining; while, on the other hand, sub-section (*b*), "Mining regulations," is noticed by some of the members interested in coal mining, and are intended principally to simplify the working and management of collieries. For the purpose of focussing the whole matter for convenient consideration the committee proposes to present:—

1. The various suggestions classified under their several headings as given in the circular issued.

2. A few remarks and criticisms upon these suggestions for the purpose of placing before the society in a form which will be ripe for criticism.

[As No. 2 really embodies the whole of No. 1, we propose omitting the latter in this very lengthy report.—Ed. C. M. R.]

MINING LEASES.

Regarding the length of the mining lease there seems to be a considerable difference of opinion as to what it ought to be. One member thinks that 100 years is a proper term and another suggests 50 years. A suggestion is made that an absolute lease should be given indefeasible, when a certain number of dollars have been expended per area.

A question of granting one lease for gold and silver and another for base metals over the same territory as is at present permissible by the mining law is freely discussed by all of the members. One suggests that any lease granted by the Commissioner of Mines should give the lessees power to mine all minerals irrespective of class.

On the other hand, Mr. F. H. Mason suggests that properties leased for metals, other than gold or silver, and which contain either of these metals, ought not to be re-leased to other parties for gold or silver unless it be proved to be a free milling gold or silver ore, and that even if the ore be a free milling ore the property shall not be re-leased to other parties so long as gold or silver are abstracted by the lessee in working base metals. If, however, the lessee does not extract this free milling gold or silver from the ore as a by-product, or by any of the various metallurgical processes, he must then pay a rental for such gold and silver areas for the whole property, or the Government may have power to re-let it for gold and silver leases.

A very sensible suggestion is made by another member, that sub-leases may be recorded in the county record office. Mr. Stemshorn raises a critical point, in suggesting that a quartz crusher be considered a necessary building at a gold mine, for which expropriation should be allowable, as in the case of shaft houses. It seems reasonable with Nova Scotia gold ore, that such should be the case, but holders of surface property have a stipulation in their grants from the Government, which only binds them to agree to so much land being expropriated as is necessary to "raise and carry away" minerals contained therein, and no mention is made of powers of expropriation of land for manufacturing purposes, and it might be reasonably argued that the quartz crusher is the thin end of the wedge, opening a way to greater concessions for large chlorination plants, etc.

ROYALTIES AND RENTALS.

All the suggestions sent in on this point are emphatic in demand for their entire abolition. Various arguments are used in support of this. An alternative, however, is proposed in case it may be proven inadvisable to abolish royalty, namely:—"That royalty should only be paid after cost of labor and explosives are deducted, say an outlay of fifteen dollars per oz. of smelted gold."

It will be observed that Mr. Stuart makes a suggestion regarding the establishment of a government assay office. Such an office would prevent the pilfering of gold which is going on at the present time and which finds a ready sale, even amongst the bankers, brokers and jewellers. It would also prevent the smuggling of gold out of the country without having first made returns and paid royalty therefor. This office could be made a reasonable source of revenue to the government and thereby substitute to some extent any loss sustained by the removal of royalties and would insure the return of all gold raised, which is not the case at present, and effectually prevent the pilfering of gold, which is the greatest drawback to the gold mining industry. Mr. B. C. Wilson suggests that the size of gold areas be increased to say about 10 acres in extent. Mr. E. Jenner's suggestion regarding a bonus for deep gold mining is one that has been discussed before, but it may be worthy of some further notice from the members of the society.

FORFEITURES.

On this point considerable difference of opinion is expressed. In some cases three months' notice is suggested as a time which should be given to a lessee before a forfeiture could be effected. In another case, it is suggested that discrimination should be made in favour of lessees who have made improvements in their properties, and that even, although the property may not be actually in operation at the expiration of the annual term, the government should have power to levy for the amount of rental due, as in real estate transactions. Another suggestion which is made, is that when a certain amount has been expended per area on any property, that such amount shall form a bonus which shall render the property non-forfeitable for a given number of years. Another member holds that no property should under ordinary circumstances be forfeitable, unless application has been made at the Mines Office for the property by some other party, and that even in that case the former lessee should have one month's notice. There is one feature noticeable in this suggestion, which might render its operation somewhat difficult, namely, that the fact of an application being presented at the Mines Office for some property which may have been lying dormant for several years, would in many cases be an indication that the applicant had discovered something which had rendered the property more valuable than its former owner had any idea of, and it would give to the former owner a prior, or it might be said a "breathing space" of thirty days, to make up his mind whether he had better relinquish or pay up his dues. Such an opportunity for "absentee landlordism" might perhaps be more injurious to the mining industry of Nova Scotia, than is even the "laying in wait game" which is so notorious at present.

MILL LICENSES.

Mr. Wilson draws attention to the injustice to bondsmen perpetrated by the government in allowing a mill to run for a year or two without returns, and states that, in some cases, the bondsmen have to make good the royalty due; the lessee having probably left the country. In such a case as this it is a pure contravention of the Mines Act on the part of the mill owner. According to section 51 every licensed mill owner shall file and return on or before the 10th of each month the weight of all quartz crushed and the actual yield in gold from the same. According to section 52 if no work has been done at the mill during the month, the owner shall make returns to that effect. If the government does not force the law, it is certainly a pity that the bondsmen should be made to suffer; although on the other hand it is easy for any bondsman who has certainly financial interest in the matter, to find out whether the owner in question is making his monthly returns.

MINES REGULATION.

Mr. R. H. Brown makes a very useful suggestion regarding the daily underground supervision of a colliery which might well be commended to the government for its careful consideration. The Mines Regulation Chapter contains a number of inconsistencies, some of which may have been passed over, while the Act was before the House where but few members had sufficient technical knowledge to be able to detect them. Nevertheless these inconsistencies render some of the most valuable sections inoperative, as may be seen from a perusal of Mr. Brown's suggestions, and it only requires a short Act, incorporating the existing Acts, and the removal of some incongruities, to place the entire Act on a sensible basis. Mr. McKeen suggests a number of amendments in the Mines Regulations. Regarding the use of explosives in mines he proposes to rescind sub-section 2 of section 8. This would have the effect, as he states, of allowing more latitude to the management. It is undoubtedly true, as he says, that many of the clauses of this sub-section are of a cast-iron nature, and no doubt some workmen will always be found in every mine who will not obey the law regarding explosives. That is an experience which has been met with wherever coal mining has been prosecuted. The rescinding of the entire sub-section, however, would again allow the storage of gunpowder in the mine, or to put it in other words, whereas in Nova Scotia today any workman can have only six pounds of gunpowder in any one part of the mine, and even then must carry it in a cannister. Such a rescinding would make it legal to carry a full keg of loose gunpowder into every chamber. In considering this question it might be well to look at what they are doing in other countries on the matter, and to read experiences regarding the use of explosives in mines.

In England, at the present time, miners are not only restricted to five pounds per blast, but they are obliged to have their cartridges ready made before entering the mine, and the result is that in English mines the explosion of gunpowder is very rare. In most of the mining States of America, regulations regarding the use of explosives in mines are very loose, each squad of men naving a keg of loose powder from which their cartridges are made as they require them. The law in some cases insists that, in making cartridges, no person shall have a light within five yards of the powder. It can be readily imagined what amount of illumination any man can have in making the cartridges under these conditions ; and it is not to be wondered at, therefore, that the law is openly violated, with the result that in the United States of America at the present time five per cent. of all accidents occurring underground are due to the premature explosion of blasting powder, and we think that these regulations should be carefully argued before they are rescinded. It will be observed that Mr. McKeen makes some very pointed comments on the existing system of granting certificates. He would suggest that in Nova Scotia the whole matter of certificates began at the wrong end of the ladder. The first class to require a certificate in this Province was the low class of mine officials, and it is only within the past few months that the head of the house, the mine manager, has been able to obtain a Nova Scotian certificate of competency.

Here again we have the experience of England and the States with which to compare. In England there are only two grades of certificates—namely, the mining manager and the underground manager. These certificates are known as first and second class respectively, and there has not yet been any attempt to carry the matter any further. In the United States, notably in Pennsylvania, the custom is to compel every man, mine foreman, boss and miner, to hold a certificate according to his station. The two higher grades of certificates are obtained from examining boards similar to those we have in Nova Scotia. But the miners' certificates are granted by local committees who obtain as their bonus a percentage of the fee paid by each miner in applying for his certificate. The law in the anthracite districts will not give a miner a certificate until he has served a certain period as a miner's laborer, but the fact of the matter is that, in spite of the law, hundreds of Polanders, Sclavonians and Hungarians secure their certificates within a short time of their arrival in the country and even before they can speak the English language, and the result is that any intelligent miner is afraid to trust his life in the same working. A very pretty problem has been unfolded in that region by the recent opinion given by Attorney-General Hetsen of Pennsylvania, that a miner means "any laborer, loader, roadsman, repairman, or any other person who works in the mines but who does not actually mine coal."

If this opinion be correct certificates will soon become a common property, although it cannot be said in such cases tnat they are any guarantee of either intelligence or safety to life. This all tends towards ridiculing the system of granting certificates.

In Nova Scotia a third class of certificates to overmen is required, and this Mr. McKeen proposes to abolish, as well as the American system, which is also in vogue here, of granting certificates to miners. It will be observed that Mr. McKeen also maintains that certificates granted by other advanced mining countries should be legalized here. It used to be that such was the case, and it is only since the passing of the new Mine Law in 1892, that any foreigner, coming into the country as manager, can only act under an English certificate, until the next following examination comes round, when he is required to compete for a Nova Scotia certificate.

It is said that a Nova Scotia certificate is not legal in any other country, although, perhaps, there is no case on record where attempt has been made to contest this point, but if we in Nova Scotia are content to accept members of, say, the medical profession holding English degrees, and permit them to practice on an equal footing with ourselves, it is absurd to reject a certificate of competency granted by Her Majesty's Secretary of State for the Home Department, in a country where the technical and practical training of mining managers is more complete than in any other country on the face of the earth.

WHAT SHOULD BE THE GENERAL POLICY OF THE GOVERNMENT TOWARDS THE MINING INDUSTRY?

On this point a number of suggestions have been made.

One member, in speaking of the inspection of gold mines as it at present exists, states that the whole thing is inadequate, and an opinion is expressed that for the purpose of affording improved facilities, the Mines office should be separated from the office of the Commissioner of Works and should be placed under a competent mining man. It is well known that the present Inspector cannot possibly devote as much time personally to the inspection of the mines at present in operation in the Province as he ought, and considering the fact that the mining industry contributes nearly one half of the entire revenue derived by the Province, it is inadequately served in the matter of mine inspection. The coal mining section is supplied with two deputy Inspectors, but with the exception of a hasty 10 days' run through some of the gold districts, by temporarily appointed men, there is really nothing done whatever in the matter.

The annual report of the Department gives but scant information as to what the various mines are doing, and members thus operating in the gold mines of the Province frequently complain that the inspection of their property rarely, if ever, exceeds an annual visit to the surface works. Regarding the suggestion that the head of the Mines department should be a non-political appointment, it is only necessary in considering the matter to compare the high state of efficiency which mine inspection and mine statistics have arrived at under the *regime* of non-political public service in England, or the really first-class service in certain portions of the United States, which in this respect is also non-political, with the want of "back-bone" which must necessarily exist where officialdom is obliged to be subservient to the pull of the voter.

The various suggestions made by Messrs. Poole and Mackay regarding publication of maps, statistics, condensed geological reports, etc., etc., are well worthy of recommendation, as are the other points regarding appointments of the Provincial Analyst, and the question of paying a bounty on the production of gold to be set aside for the development of the gold mines.

MINING EDUCATION.

Its Necessity.—An opinion is expressed by some members that the time is now ripe for some form of mining education in the Province. It might with equal propriety have been said that the time has been ripe for quite a number of years. There is no Province or State from which there is a greater exodus of youth than Nova Scotia. We have the most diversified wealth of minerals and metals of any territory of similar size, and there is a wide field for the chemist, geologist, mineralogist and miner. The trouble all along has been, however, that unless a young man has a taste for the bar, the pulpit or the surgery, and cares to run the risk of earning a mere pittance in one of these already overcrowded professions, his only resource is to fall back on the farm or to emigrate to the States. If further proof of the necessity of such an education was required we have only to read the history of mining in Nova Scotia, to recall the blunders and blindfold policy which has all along been indicative of our provincial mining knowledge. With the exception of here and there an able miner, and he not native in every case, the industry has been in the hands of men whose ideas were crude and whose methods of prospecting and mining were of the rule of thumb or divining rod order. It is the experience of many members of this Society that where fathers have made application to have their sons "put to something," it was but seldom that their knowledge could be valued at over $1.00 per day, and as that could be earned at the farm, back the lad went. If an opportunity could be offered of obtaining such an education as would fit our youth for the mining business, there are many who would respond. The only necessary stipulation is, that an education must be easily and cheaply obtained to make it attractive. To do this we must have the aid of the Government. What is our claim for Government aid? According to the accounts of the Provincial treasurer, the entire income from the Province, independent of the Dominion subsidy, was $542,168.13 for the year ending Sept. 30, 1894. Of this amount $242,053.13, or nearly 45% of the whole, was derived directly from the mining industry. The total expenditure of the Province during the same period was $1,004,-419.43, and the total amount expended on the mines was $12,899.25, or about 1¼% of the entire expenditure. These figures are not presented with any idea that the mining or any other industry should obtain as great a percentage of the Government expenditure as it contributes towards the income ot the Province. The statistics are simply given for the purpose of comparing with the agricultural industry, which already possesses a State-aided technical school in the Province.

The total income derived from the agricultural industry is $587.49, or $\frac{1}{10}$% of the whole, while the Government expends $20,041.74 on agriculture, of which $2,955.84 goes to the school of agriculture. This is equal to nearly 2% of the Provincial expenditure.

Of the $12,899.25 expended on mines $599.95 was for instruction to coal miners preparing for their examinations. This year the amount of this item will be over $1,000.00. The foregoing figures show that considering the relative importance of the two industries, the one in which we are interested is not by any means receiving its share. It may seem at first sight that these figures show a want of appreciation on the part of the government, but it is questionable whether it is not as much due to a lack of community of idea on the subject on our own part. The agriculturalists are united as to the form of education and experimental farming most suitable to their re-requirements and they thus get their slice of the government bounty. It behooves us therefore to formulate some system of education and show the government our unity of desire in the matter, which is the first step towards obtaining the desired assistance.

Nature of Instruction Required—The suggestion made by Mr. H. T. Harding is that a "School of Mines" be established in Halifax, possibly as an annex to Dalhousie. At that college there is at present a lecture on mining and one on surveying, and according to the calendar of the college for 1895-96 there were no students last year. The reason for this is probably due partly to the fact that the matter is not brought before the public with sufficient prominence to secure good attendance. Another reason, however, and a more important one, is that the subject of mining at Dalhousie is what might be termed "a small side dish." It is not reasonable to suppose that a young man whose aim is to take a degree of mining engineer will look with much desire upon such a course as the faculty affords him at Dalhousie, so long as he can reach the higher and more coveted degree to be obtained at one of the better known universities which make a specialty of a mining course.

It may therefore be readily seen that to have weight and influence which will attract and hold classes some school must be established, such as a School of Mines, where chemistry, physics, mechanics, etc., will all be taught, not only in a general way, but more particularly in their relation to mining, and with the constant aim of eventually turning out first-class mining engineers. It might be well at this point to refer to what is being done in the Upper Provinces of Canada in the way of mining education. At Kingston, Ontario, a School of Mining has been established and incorporated by Act of Legislature. Three and four year courses are given, intended to fit young men for the professions of mining engineers and metallurgists. The fees for the four years' course aggregates to about $200. There are three professors, five lecturers, and two laboratory demonstrators. The expenditure last year was about $16,000. Against this there were three sources of income, (1) *A grant from the Provincial Government of $10,000*, (2) fees amounting to $2,249.00, and (3) public subscriptions to the amount of $2,600.00, making a total of $15,949.00, so that the two sides of the ledger would have been about equal, had it not been for the fact that there is a "Dairy School" whose accounts are mixed up with the School of Mining, with the result that there is a total balance on the wrong side of over $2,000. Evidently agricultural education in Ontario is as big a drain to the Government as in our own Province.

Besides the ordinary mining engineering course there is a prospector's course for mine foremen, etc., which lasts for eight weeks each year, and for which a fee not exceeding eighteen dollars is charged. There is another feature in this question of technical education which is well worth looking into. This is the English system of sending out lecturers to the various mining centres to deliver lectures on chemistry, geology, prospecting, mineralogy, assaying and practical mining. These lectures are free to every one and the entire expense of this method of tuition is borne by the various county councils at a cost of a thousand to fifteen hundred dollars per county per annum. The advantage claimed for this system of instruction is that it takes the education to the student, instead of requiring the latter to leave his work for a season to attend classes every winter. The Government of Nova Scotia has for some years by means of local instructors, been expending considerable sums on this form of instruction amongst the coal miners for the purpose of raising the general standard of their knowledge and assisting those who intend presenting themselves for an underground manager's certificate.

In Nova Scotia where gold and coal mining industries are both so important classes would be required to be formed dealing with all points of the subject of mining, and to best maintain interest in the school it would be necessary, we think, to embrace the Kingston School system, with the English method of district lectures. Mr. Pool's suggestion that primers on mining be introduced into all schools in mining localities is a good one and should be brought to the notice of the educational department.

The whole subject dealt with in this report is worthy of the appointment of a committee which would have power to formulate a thorough programme for presentation at a special meeting of the society, to be held during the first week of the Legislature, with the object of submitting the same to the Government and Legislature, or the committee might have power as the representative of the society, after fully preparing the plan, to present it without further delay to the Government.

MR. BLAKEMORE moved a vote of thanks to the committee for the able and exhaustive report which had just been read.

MR. MASON seconded the motion, which carried.

MR. PEARSON suggested that the members take with them copies of the circular issued by the Secretary and note on them any comments they might mish to make during the discussion at the afternoon session.

Meeting then adjourned.

Discussion on the Report.

The afternoon session opened at three o'clock, the President in the chair.

MR. BLAKEMORE—I would suggest that as gold mining legislation occupies the bulk of the report, the gold miners commence the discussion.

MR. HAYWARD—I notice a clause in the report recommending that the Government encourage deep mining by allowing a rebate on royalties for such. I think the distance mentioned was about 600 feet. I believe we have reached in some of our mines a greater depth. If they would offer a bonus per foot for every foot over 800 in all shafts it would encourage deep mining.

MR. AUSTEN—If my recollection serves me, we had a committee appointed to look into the amendment of the Act relating to Gold Mining, and we have somewhere a report of that committee. In talking over the matter with some of the members of the Association, more particularly the gold miners, they suggested that at this meeting a committee should be appointed to look over the suggestions of the former committee and make any alterations they thought necessary and bring it before the Government.

MR. WILSON—I thought this was the only committee, and that the idea was that another committee should be appointed to draft and Act. As far as discussion by the gold miners is concerned, we believe we were somewhat in the position of the young man who posted his prayers at the foot of his bedstead and said, "Lord, those are my sentiments."

THE SECRETARY—Mr. Austen, I think, is referring to the old committee of the Gold Miners' Association. I thought their amendment was presented to the Government and went through.

MR. G. W. STUART—The concensus of opinion among gold mining men is for the abolition of royalties altogether, if that can be accomplished, and in that case the necessity of making any distinction between gold taken from the upper and lower levels would be done away with. There would be difficulty in determining in what part of the mine the gold was obtained. It is not at all improbable that gold obtained from levels above 600 feet might be credited to lower depths.

MR. BLAKEMORE—If the Government helps you to sink that shaft, why would you not be willing to pay the same royalty, the supposition being that you need help to go lower?

MR. STUART—The suggestion is not only to ask the Government to relinquish the right to royalties on gold found at lower depths, but to give a bonus for gold found at lower depths.

MR. BLAKEMORE—I quite agree with the committee that the Government should assist persons prospecting at lower depths, but the other question of the abolition of royalties is one by itself entirely.

MR. HAYWARD—The Government should assist by a subsidy per foot measuring on the slope of the vein, or by relinquishment of the royalties.

MR. AUSTEN—Some years ago the Government were approached and asked to grant a subsidy of about $10,000 for the first mine that would sink a shaft to a greater depth than $1,000 feet.

MR. HAYWARD—Mr. James Fraser and myself presented that to the Government. I suggested that they relinquish their royalty on all gold found under a certain level.

MR. STUART—I have always maintained, ever since the Government adopted the system of rentals, that they should relinquish the right to collect royalties. The rentals make up an amount about equal to that of royalties. Instead of being a benefit to the gold mining community the adoption of the system of rentals has been an additional burden upon us. I am prepared to support the only suggestion I made, embodied in the report, that of abolition of royalties, adopting a system of a Government assay office where all gold will have to be produced and assayed. I will withdraw that part as to assaying. I must admit that it would be putting the Government to considerable expense, perhaps more than they would be disposed to incur in establishing an assay office wherein they could determine the exact value of every piece of bullion presented, but let the gold be presented and weighed, the weight stamped thereon, and the Government's official mark, before it could be offered for sale. You would simply make your returns to that official instead of to the department; then your gold could be presented anywhere for sale as being legitimately obtained. As it is now, any one may offer a piece of bullion to a banker, broker or jeweller without being asked a question. He may have stolen it. I can quite assure you that any man in business would hesitate before undertaking to purchase a piece of bullion without the Government mark if it could be confiscated if found in his possession. The Government would be doing an injustice, not only to themselves, but to the mining community did they permit us to obtain our gold and not be obliged to make returns somewhere. They must have some system of determining the amount of gold obtained. I don't see how it could be considered a hardship on any man producing gold to compel him to have it officially stamped. If he were in the country, he would not have to come to Halifax to dispose of it. He could hand it to the nearest bank and make a statement how it was obtained. The bank's office in Halifax could produce it before the Government official, who would weigh it, stamp it, and place his official mark upon it. The miner would not be put to one cent more of expense in connection with it except the nominal fee which might be charged for the duties performed by the official.

MR. MASON—If you had the specific gravity taken also you might approximate the value.

MR. AUSTIN—The banks do not allow the full amount now. They keep back a certain percentage.

MR. STUART—Gold sent out of the country without the official stamp could be followed and confiscated anywhere.

MR. AUSTIN—I should think that it would be something that the Government would jump at because they would be more certain to have the returns.

MR. HAYWARD—I would suggest that the Government be asked to subsidize all mines worked over 800 feet $15 per foot.

MR. STUART—I am not wedded to any particular system in order to obtain the full actual amount of gold that is produced. All I want is to prevent if possible the pilfering that is going on at present. I know a mine in Nova Scotia that was worked for a number of years. It was a good mine and a productive one, and it has been said, and I believe it to be true, that the manager of that mine made two trips abroad every month. I know two bricks were made every month at that mine. It is said returns were made on one brick, while the other was spirited off to the United States. There may have been an object further than that of defrauding the Government of the royalties.

MR. AUSTEN—There is supposed to be another mine in Nova Scotia that never makes any return and the manager has been working for years.

MR. STUART—In the particular instance I speak of it is a well known fact that the manager made periodical visits to the United States and his grip was a very heavy one.

MR. HAYWARD—How would the stamp on the gold prevent that?

MR. STUART—You could seize the grip. I am quite satisfied that if such a system were adopted the returns would be swollen at least one-third over what they are at present.

MR. HAYWARD—I was in a broker's office some time ago and a fellow out of our mine came in and sold six-and-a-half ounces of gold.

MR. MORROW—I have listened with a good deal of interest to the discussion, and thought there would be some suggestions from the others on the committee. It appears to me that the best thing for us to do would be to let this Report be discussed here in a cursory way and then let it be referred back to the committee. We should also nominate additional members to that committee, men posted on the different branches. Then the committee so enlarged might appoint three sub-committees, one for each matter, the coal, gold, and other mining interests. When they prepared some scheme for each of these let them go back to the whole committee and get their report in shape for submission to the Government. This is apparently vague, but I only make this suggestion thinking it might help us to come to some decision.

MR. B. F. PEARSON—I may say that the last part of the report suggests that course. The committee has not met often and I am afraid that they have not tried to gain for the report the full sanction of the committee. Really, the only meeting we had was that of last evening, and some question was raised as to how far we should go in making suggestions, which, of course, are numerous, and some of greater importance than others.

The really important one, it seems to me, and the one lying at the base of successful mining, is the question of the title to mines. Of course, I quite recognize the necessity of preventing stealing by employees, yet if they start with a poor title it makes no difference. You go to the Mines Office and everything is run on a basis on which no two intelligent men would trade at all. No man would rent a house on a lease containing such restrictions as are embodied in the one on which we take a mine. No one would rent a house, for example, under a lease which would give the landlord power to decide when and how the agreement was broken, enabling him, having reached a decision to turn the tenant out. No one would invest one hundred dollars in Nova Scotia mines if we were really obliged to conform with the provisions of our leases; and, therefore, the only security the miner has is in the negligence of the Government in failing to inform themselves whether or not the conditions of the leases given by them are carried out by the lessees. In other countries the title is a freehold one, but in Nova Scotia a different system is adopted, and the Government owns the mine and simply leases its interest in the soil. It stands also in another capacity of representative of the public interest; and, unfortunately, when it legislates with regard to mines the fact that it should legislate as a landlord as well as the representative of public rights is entirely lost sight of. The Government as landlord has a right to have equitable security for the payment of its rentals, that is all. Of course we all recognize on the other hand its right to see that the mine shall be so operated that there is no danger to employees. They give you a lease that they can forfeit in thirty days. If you are brought before the court by summons the court will order three or four months' notice to be given where necessary; but here we have a man with his whole capital endangered if he does not get a notice which they may stick up somewhere in the woods. Forfeiture should only extend to the case of non-payment of royalties. We thought last night of the two or three classes who dabble in mines. There is one special class who never invest a dollar and who take up single areas in the midst of those owned by others simply to cause annoyance and have themselves bought off. I do not speak on behalf of that class. I do not think any sympathy should be shown them. But in the case of a man who really intends to operate a mine and be of value to the Province, I think there should be some provision in the law by which he could get a lease fully protecting his rights. We thought the law should be amended to provide for a permissive lease, say for fifty years or some longer time, with all these provisions struck out, and letting a man pay his rental in advance or for five or ten years. Under the present condition of things a man has to go to the capitallist and give him two dollars worth of stock for one dollar, but if he could show a lease granted by the Government with only one condition of forfeiture, namely the non-payment of rent, and say "I have paid ten years in advance," his security would be good and he could give a bond on it. There is a great deal to be said on that point and I think the mine owners will approve of it. We should therefore start with the question of getting the title all right.

Take a coal mine. The owner represents capital and the employee the labor. Everything should be done to protect the latter below ground, but to say that no man can go under the turf without a certificate is preposterous. Mind you the mine owner has not a word to say about that certificate, but I am informed that the man who issues it is the man who works at the pit-head. The mine owner whose property is imperilled has not a word to say about the granting of these certificates. Who does the law recognize in the granting of certificates to medical men? The Medical Society. Therefore I think the mining certificates should emanate from this Society, which represents the proprietors of the mines.

There are other questions that could be talked of relating to coal and gold mines. I am not a practical miner, but I am very much interested in mines in this Province, as they are not developed to one-fifteenth of their capacity. Every legislature says, "Let the mine owners tell us what they want." It was for that purpose that this committee was appointed, and no Government can ignore what this Society demands, if it is proper and is properly submitted.

A great deal may be said on the question of school instruction. It seems to me that a proper mining school would not cost more than $25,000 to equip as well as the Massachusetts Institute of Technology. Every proprietor will recognize that the greatest difficulty is not a plethora of men, but to get men who can and will do the work. If you find the right man you are prepared to give the best wages. The only way to do is to establish schools on the plan of the Agricultural School, which would be visited and examined by the members of this Society and be somewhat under its supervision and control. I think this committee should be enlarged. There are a number of men even outside the Society who would strengthen it politically. We should be prepared to go to the Government during the first week of the legislature. If the Government did not grant what we required, we could ask for a committee of the House. I therefore support Mr. Morrow's suggestion.

MR. BLAKEMORE—I have felt all along that this is too big a subject to be threshed out at a meeting of this kind. It can only be dealt with satisfactorily in committee. The concluding part of the report just meets my views, viz., that we should re-elect the present committee with power to add to their number and take the matter in hand with a view of bringing it to the conclusion foreshadowed in the last clause. I am quite sure that so far as the coal mines regulations are concerned, there is enough to consume a day or so. The members can send in any suggestions they may wish to offer in writing and let the committee put them in shape and deal with them. I would have every confidence in such a committee and would give them *carte blanche.* This is a composite Society, and the coal men do not take much interest in-gold matters and *vice versa*, but that difficulty does not exist in a committee where all interests are represented.

I might be allowed to say a few words on behalf of the coal interests. We have a considerable number of difficulties, which to my mind are likely to become intensified. From what I can glean, the parties responsible for these difficulties are probably in sympathy with progression in the same direction. The first thing to consider is the safety of the men employed in that industry, and no capitalists have the right to weaken the security which the men get at their hands. It is difficult to frame an Act which will give the maximum of security to the men employed in all the mines coming under the Act. Mr. Fergie has a mine full of gas, and the rules which would be safe in my mine would not be safe in his, and you must give separate legislation for each of us. There are as great divergences in Great Britain, but there is one Act for the whole country, and you must inflict a hardship on the majority in order to protect the minority. Over there they have special rules. Every mine has a right to formulate them according to their own peculiar conditions. After being drawn up, it is imperative that these rules be posted, and during a month any man may make a formal objection. In the event of that the rules are tested. If there is no formal objection at the end of the month they must be accepted by the Government. That has not been taken advantage of in our mines, and it would help us out materially.

MR. FERGIE—It has been taken advantage of in Pictou county.

MR. DICK (Joggins)—And in Cumberland.

MR. BROWN—We use that system in Sydney.

MR. BLAKEMORE—In reference to certificates I would point out how the present system is a hardship to the employer. The men who grant these certificates are workmen themselves and have absolute and arbitrary power, and there is no appeal. Suppose there was a matter in dispute between an employer and his men it would be impossible to have other men employed there if the man granting the certificate should say that any particular man should not work there. It gives this man too much power. As to the necessity for the certificates there can be no question. In England it is only asked that the manager and his deputy should have certificates, and it seems anomalous that in this country where there is not so much danger, certificates should be required from others.

There is one other matter which was brought up by Mr. Brown. The Act says that the mine shall be under the daily supervision of the manager. In England that was the first thing which came up for discussion, and it was got over in this way. It was assumed that that must be interpreted liberally and not literally, and so long as there was a resident certificated manager, and he had his proper deputies, their examination would be considered as his, and the deputy could do it so far as the "daily" examination was concerned. That interpretation was accepted by the judges. If they would not accept such a rendering here the Act should be amended.

I have been very much struck that in a country like Canada, with our population and the extent of coal mining, there should be such a diversity in the Coal Mining Acts in the different Provinces. This Society has a position and we should take advantage of that position to place our views before the Government in the proper form.

I will conclude my remarks by making a motion, viz :— "That the report of the committee be accepted; that the committee be reappointed with power to add to their number, subject to the approval of the President; and that they be respectfully requested to carry out the intention of the report as foreshadowed in the concluding paragraph."

This was seconded by Mr. Willis and passed.

THE PRESIDENT—Suppose you are a certificated manager of a colliery, and you take a trip to England, if an accident were to happen during that time the question would be raised how could you, being absent in England, make a daily examination?

MR. FERGIE—Your underground man can make that daily examination.

MR. PEARSON—A law is made which cannot be carried out. If an accident occurs, and the company is sued for damages, it is not what the Government may or may not say, but the company is held strictly to the construction of the law. It seems to me that we might get together the nucleus of a library. Mining statistics and the mining statutes of the different countries are interesting and a large number of such might be donated by the members. I have a number of books which I shall be happy to present to the Society. I would move that the President be empowered to appoint a library committee of such number as he sees fit for the purpose of forming a library and increasing our exchanges.

This was seconded by Mr. Fergie and passed.

MR. STUART moved that the Secretary be instructed to have a number of the findings of the Committee on Legislation struck off and distributed among the members, together with a copy of Mr. Blakemore's resolution.

Seconded by Mr. Blakemore and passed.

MR. WYLDE moved that a resolution of condolence be conveyed to the members of the family of Mr. Reid, who died since the last meeting of the Society.

Seconded by Mr. Fergie and passed.

Meeting adjourned till 8 p.m.

The evening session opened at 8 o'clock, when the following papers were then considered :—

On the Occurrence of Galena at Smithffeld, N. S.

By JOHN E. HARDMAN, M.E., Montreal.

At intervals, during the last dozen years or more, public attention has been drawn to the attempts which have been made to imbue with economic importance the deposits of galena found at and near Smithfield, in the County of Colchester, N.S. Numerous examinations and reports have been made by different men, but these reports, to the writer's knowledge, have never been published in full, only garbled or incomplete extracts having been given to the local and the mining press.

During the past summer the writer has had opportunities, as consulting engineer for the Dominion Smelting and Refining Co., Ltd., for a somewhat extended examination of these deposits, and, by the courtesy of the directors of that company, he is enabled to lay before you the following brief account of the deposit and its history.

Beginning about a mile or more west of the settlement known as "Smithfield," and extending easterly as far as the settlement of Pembroke, both in Colchester county, there have been found along the line of junction of the lower carboniferous shales and limestones, numerous pebbles, boulders and occasional masses of both coarse and fine-grained galena, accompanied with pyrite, and occasionally with sphalerite or zinc blende. Many of the shales are gritty and are interstratified with sandstones, and much of the limestone is dolomitic, and impregnated with small cubes of pyrite. Little or no quartz is seen in place, and no structure resembling veins can be observed.

The large quantity of float galena, and its comparative purity, found at Smithfield, early drew attention to the locality, and a considerable amount of lead ore was seen in the first openings made. The dip of the rocks at this point varies from 60° to 80° to the southward, occasionally reaching 90° or vertical; the strike of the measures is not uniform, but the general trend is east and west. The limestones overlie the shales and sandstones, and are conformable. The country is remarkably free from faults or dislocations of the strata.

In 1883-1884 an attempt was made to work the ore at Smithfield by Messrs. Brown and Edwards, the latter being a metallurgical student from Swansea, with much experience there.

A small brick shaft furnace was built, having two 5-in. tuyeres, and the blast was furnished by a Sturtevant blower; I regret that the furnace is in such a dilapidated condition as to preclude any measurements being taken of its interior dimensions, nor is there any dump of slag in the vicinity from which to judge of the quality of the work done. But it is known that the attempt to smelt was unsuccessful, and the remains of one or two roasting piles (for heap-roasting was all the preparation the ore received) show that the ore entered the furnace practically in the raw state.

No records are available from which to obtain the amount of ore raised during this period of activity, and the mine openings unfortunately give no clue to the percentage of galena in the rock extracted.

After the failure of this attempt the property lay quiet for several years, being examined in the interim by Capt. John Nichols, well known to the gold-mining members of this Society by the fiasco at Mt. Uniacke, and at "Jumbo," near Westfield. It was also examined by another English mining captain, named Evans, whose report was most favorable, and who saw no difficulty in raising 50 tons of ore a day.

In 1894, the Dominion Smelting and Refining Co. took over the property on the strength of these reports, and decided to ascertain the commercial value of the deposit.

Prior to 1894 all the development done had been confined to about 150 feet in length of the strata lying immediately to the eastward of the highway at Smithfield. Three shafts had been sunk to depths ranging from 30 to 60 feet, from two of which came the ore which the furnace was erected to smelt. From reliable information received from Mr. Edwards, and from men living at Smithfield, it appears that both of these shafts passed through the ore body (?) and entered barren ground.

The Dominion S. & R. Co. sunk two shafts, one to the eastward, the other to the westward of all previous work, during the winter of 1894-95. The east shaft (No. 1) reached a depth of about 47 feet; at 45 feet levels were run both on the strike of the measures, and cross-cutting the same, but failed to find any ore, though a considerable amount of pyrite boulders, carrying some galena, were found in the surface before reaching bed-rock. In the west shaft (No. 2) no ore was found, though a cross-cut was driven to the south for 21 feet.

As the Dominion S. & R. Co. was distinctly a commercial undertaking, it was manifest that the first thing it had to ascertain was whether there did, or did not, exist on the property a defined vein, bed or deposit of lead ore of sufficient magnitude and value to warrant development, and the subsequent erection of a proper mining and smelting plant. To this end the company were advised to purchase a coring drill. During the summer of 1895 holes were bored by this drill at various points on the property, and one of the oldest shafts was unwatered and subjected to a careful and thorough examination of its headings.

None of the cores obtained showed galena, excepting in one instance, and in this one case subsequent tests showed the core to be from a boulder. It was found that there were several beds of dolomitic limestone that carried pyrite, but the deepest bore-hole failed to reveal any deposit of galena.

An examination of the old workings confirmed the view obtained from surface examinations and from the cores, viz., that the galena occurs in decomposition cavities in the limestone, associated with a reddish clayey gonge which is doubtless colored by the iron occurring in the limestones. The ore in these cavities varies in size from mere strings or nodules the size of a walnut to masses containing several hundred weight, which rarely are connected with each other.

It would appear that the pyrite in these deposits was formed before the galena, as a specimen obtained from No. 1 shaft showed three globular nodules of pyrite cemented together by a fine-grained galena. A section of the pyrite nodules showed concentric structure.

In a cross-cut driven 32 feet across the strata were seen exposed beds of fine-grained dolomite impregnated with pyrite, in some cases to the extent of 20 per cent. Also beds of dolomite entirely barren of mineral.

In this cross-cut were clearly seen two ore-zones (if they can be dignified by such a name), in each of which it was observed that the small deposits of galena found lay in a limestone pocket associated with a stiff red clay or gonge.

It was also noted that these small stringers and nodules of galena were more frequent near the surface than in depth, but the rarity of their occurrence at all was a more striking fact.

The mode of occurrence of these small and widely scattered patches of ore, their irregularity, and the failure of any of the deep bore-holes to locate any deposit at depth, led to the conclusion that the property does not possess lead ore in quantity sufficient for a commercial venture.

The similarity of this occurrence of galena with the deposits of lead ore in south-western Missouri might lead one to expect larger and perhaps profitable deposits along the line of these mineralized strata in Colchester, and it is possible that extended exploration may yet discover them, and form the basis of a lead industry.

DISCUSSION.

MR. F. H. MASON—I regret that I was out of the room when Mr. Hardman's paper was read, but I have had an opportunity of reading the paper since and there is one statement which might be misleading to those not acquainted with the lead smelting industry. Mr. Hardman refers to Mr. Edwards (the metallurgist who superintended the erection of the furnace and working of the same when the Southfield mine was in operation) as having had considerable experience in Swansea. From this remark it might be inferred by the uninitiated that Mr. Edwards was using Swansea methods. So far as I have been able to learn Mr. Edwards came to Nova Scotia directly he had completed his apprenticeship at a Swansea smelter establishment. But be that as it may one thing is certain, Mr. Edwards was not using Swansea practices at Southfield. In 1891 I paid an extended visit to the Swansea and Llanelly smelting works, and except in one or two cases where Piltz furnaces were being experimented with, the Reverbatory furnace alone was used in the smelting of lead there. As Mr. Hardman states in his paper the furnace at Southfield is too dilapidated to get a very accurate idea of its construction, but so far as I was able to judge it appeared to me to be a modification of the Scotch Hearth. I took some samples of the pile of roasted ore when I visited Southfield, and as far as I can remember they averaged a little less than 30% of lead. I venture to state that no experienced Swansea smelter would operate on raw ore of less than 60% lead, while as a rule they like it dressed to 80% lead.

In the Flintshire lead district of North Wales, it is no uncommon thing to find large boulders of galena often associated with blend in the carboniferous limestone, and at the Halkya mine in that district, a mine which paid its shareholders from 100 to 125 per cent. for several years, a deposit of clay containing boulders of galena was profitably worked. The true veins in Flintshire are usually found at the junction of the limestone and chert, but a considerable amount of mining for boulders in the limestone has been carried out there.

A Mineralized Zone in Nova Scotia.

By Henry S. Poole, M.A., A.R.S.M., M.E.

In connection with the workable deposits of limonite, pyrolusite, galena and barytes in lower carboniferous rocks of Nova Scotia it was only recently[1] that the writer realized that an important fact of economic importance, hitherto but partially understood, has been made evident by the researches of officers of the Geological Survey, Messrs. Hugh Fletcher and E. R. Faribault.

Before proceeding further it may be well to premise that this paper is to be taken as purely local in character, that its generalizations are confined to Nova Scotia alone; at the same time it will be apparent that the conclusions stated are based on an experience very similar to that acquired in other parts of the world, but which it has not been possible to here apply, until a detailed topographical and geological survey map had been prepared.

Hitherto a discovery in a new locality of either one or other of the minerals in question has been followed by prospecting more or less efficient. The skill brought to bear in the search has been practical, though often without system, until experience has supplied a local knowledge for the broad fact which now seems to be established, the limitation of such mineral deposition to a particular zone in rocks of this horizon, has not as yet become generally known. Nor would proof of the statement be so confidently expressed now but for the negative results that have attended explorations outside the zone that is limited by the immediate neighborhood of the contact of the carboniferous limestone series with rocks of older groups or formations.

The fact presented may be said to centre in the mapping of certain localities by Mr. Fletcher and the distinct division of groups of rocks hitherto generally shown together as lower carboniferous; the distinction he has drawn would appear to be clearly justified by this fact which it itself makes evident and of practical value.

As to the age of some of the older series of rocks in contact with the limestones, plaster and associated beds of the carboniferous limestone division there has been and probably is still a difference of opinion among geologists, but whether the rocks in question are members still lower in the carboniferous system, or whether they are of the highest series of the Devonian system is of small importance to the miner so long as he is able to distinguish them apart by their physical characteristics alone. This is not difficult to do after studying some well defined locality; and an examination of the upper series will show the presence, besides plaster, which does not occur in quantity in the lower beds, of flaggy and well bedded sandstones and grits, suitable if not for building purposes at least for foundations; while the sandstones of the older series it will be seen cannot be dressed under the hammer, but breaking with a cross fracture, are unsuited for any but the roughest of walls.

Great disturbance and faulting have taken place in both groups, but the older has been shattered and brecciated to a very marked degree. When the argillaceous or clay beds in both are compared together, especially when hand specimens are taken, the difference is not so easily seen, but in mass the red shales of the older series have a slatey appearance and most of them will be found to break into knife-edged fragments, a form which those of the newer or carboniferous limestone series are not found to take.

The value of the contact of the rocks of two geological systems as a site of metalliferous deposits has long been recognized in several localities; and without attempting to follow the history of this recognition it will be sufficient to mention the following instances:

Sir William Dawson in his Acadian Geology, 1868, page 272, quotes Mr. Barnes and Professor How of King's College, as reporting a deposit of fibrous brown hematite at Brookfield at or near the junction of rocks probably of Devonian age, with ordinary lower carboniferous shales and limestones which would seem to be unconformable to them.

Mr. Donald Fraser, of Springville, who conducted explorations for iron ore along the East river of Pictou, dwelt on the importance of the "juncture"; and Dr. Gilpin writing in 1874 of the same locality, said:— "As far as investigations have been carried the limonite has been found at the point of contact of lower carboniferous with upper silurian strata." [2] Sir William Dawson[3] referring to the same ground, wrote:—"At the line of junction of the carboniferous and older rocks on the east side of the East river of Pictou occurs the great limonite vein of the district, forming a vein of contact of exceeding richness and value. It follows the sinuosities of the margin of the older rocks and varies in thickness and quality in different places." In the following year Dr. Gilpin notes the importance of the limestone at the contact and writes:—[4]"'From Springville for several miles up the East river the line of contact of the marine limestone and silurian follows closely the course of the river. At several points the ore has been proved to rest on the silurian clay slates and has limestone on the hanging wall and in places holds notable quantities of manganese."

The writer[5] in his report for 1874 on referring to the galena deposit at Gay's river said the limestone beds in which the ore is disseminated "lie horizontal on the irregular surface of the unconformable silurian (cambrian) rocks, and judging by the fossils found in the extension of the beds further west, are lower carboniferous, and contemporaneous deposits with the auriferous conglomerate worked five miles away to the eastward."

The auriferous conglomerate here referred to was spoken of in his previous report as a contact deposit in a district that was described in 1866 by Dr. Honeyman.[6]

At Smithfield in Guysborough County explorations in 1875-77 on a vein of galena led the writer to remark[7] that hopes were entertained an improvement would be found "at the intersection of the vein with the change of formation, which is presumed to be near at hand." This locality is fully described by Mr. Faribault in his report for 1886. He goes on to say:—[8] "Galena was found in large quantity at Smithfield on the south bank of the West river of St. Mary's, two miles west of Glenelg, where it occurs in small veins cutting the narrow belt of quartzite left between the granite of the south side of the river and the overlying carboniferous conglomerate."

Professor How in his Mineralogy of Nova Scotia, 1868, page 45, referring to the report of Mr. H. Poole to the Government in 1860, remarked:—"Mr. Poole found a conglomerate, resting unconformably on slates near Avour's Head, Digby County, which contained gold and native copper."

These references are sufficient to show that the mineralized character of the base of the carboniferous system at several localities had been noted years ago; but these and similar records of isolated spots were not sufficient to warrrant any general conclusion respecting the value of the contact beds of the lower carboniferous, nor to have them classed as the exclusive mineral zone of that system, nor indeed so far as is known was any general deduction respecting it either published or suggested. Now, however, in the reports and in the unpublished works of the Geological Survey we have in addition available for generalization a mass of data from which a few extracts bearing on the subject in question, may be taken.

On turning to the official reports referring to Cape Breton we find Mr. Fletcher[9] remarks:—"Mention has already been made of a number of places showing traces of copper glance, oxydized to carbonate, impregnating a conglomerate, often at its contact with an overlying bed of limestone, as at Irish Cove, East Bay, Washaback, Middle and North Rivers. At Loran, two or three miles east of Louisburg, coarse red carboniferous conglomerate overlies the older rocks. The matrix of this conglomerate sometimes consists of hematite which also discolours the underlying felsites."

Everything[10] tends to prove that the iron ore (of Big Pond) is a deposit at the contact of the carboniferous and precambrian formations like those seen near McDougall's Point and elsewhere; and in mining these deposits this circumstance should be kept in mind and the ore followed along the line of contact. . . "Further explorations have been made in Cape Breton County and elsewhere by persons interested in the contact deposits of red hematite."

[11]"A considerable quantity of galena was discovered in the limestones overlying the Devonian at the head of Arichat Harbour."

[12]"The pyrolusite of Loch Lomond is probably of the same nature and origin as the hematite, and forms at times a cement for the pebbles of the conglomerate. 'As already remarked many of the lower carboniferous limestones hold traces of galena. At Pleasant Bay near the mouth of McKenzie River, calcspar veins in a dark bitumenous limestone, surrounded by the underlying gneiss hold golena, which is also disseminated in the limestone and grit, contains both silver and gold, and is associated with copper pyrites, iron pyrites, fluorspar and bitumen.' 'The copper ores of Cheticamp are situated in the vicinity of the trap and sandstone of the base of the carboniferous.'"

Coming now to reports of more recent date having reference to Nova Scotia proper, Mr. Fletcher remarks:—[13]"At Brierly Brook on the Ohio river and near Beaver Meadows, copper ore is found at the contact of the carboniferous limestone and conglomerate good specimens of yellow and purple copper pyrites being obtained at many points."

"At Smithfield,[14] Colchester county, galena, pyrite, blende and calcspar are intermixed in what appears to be a brecciated vein at the contact of the limestone with quartz-veined Devonian rocks. At Pembroke galena is in fossiliferous limestone, also near the contact with red and grey Devonian slates."

"In the neighborhood[15] of the iron mines at Upper Brookfield a vein of reddish and white barite, said by Prof. How to be 15 feet in thickness, is exposed on the side of the hill, mixed with iron ore." . . . "Next to the gypsum in Hants county the most interesting member of the carboniferous limestone formation is the red basal limestone, along which the manganese ores are found. . . . Boulders of pyrolusite[16] found one mile north of Kennetcook Corner, perhaps indicate a contact with the carboniferous limestone now concealed by drift." . . . "Nearly all the other worked deposits of manganese, however, occur in or near the limestone described above as lying at the base of the carboniferous formation, the ore being near the top at Cheverie, at the bottom at Walton, and in 37 feet near the bottom at Tenny Cape Mines.[17] . . . Devonian sandstone or quartzite forms the floor or footwall of the mine. . . . The ore of this belt has been traced for a great distance east and west and is also found in small outliers among Devonian rocks."

"The Goshen[18] iron mine is situated at the contact of this limestone with the Devonian, just as are those of Clifton, Selina, Brookfield and the East river of Pictou. Here a mixture of limonite, hematite, barite and calcite is found in a dark grey limestone. Barite occurs in considerable quantity in veins in limestone at Walton and Pembroke."

The red hematite of Newton Mills is a deposit at the junction of the carboniferous limestone and conglomerate with the Cambrian gold-bearing series, and similar ores may be expected at other points along the line of contact. . . . The limonite of the Brookfield iron mine is also at or near the base of the carboniferous. At the same horizon, probably, are the manganese mines of Tenny Cape, Walton, Cheverie and East Onslow. . . . A careful survey of the Devonian rocks and carboniferous limestone of the East mountain of Onslow and Penny's mountain, in Clifford's and Farnham's brooks, has shown that the latter rests in small patches on the former, with the most complete and satisfactory evidence of unconformity, and unconformity scarcely less evident is seen also at Walton and Cheverie."[19]

Mr. Faribault remarks:—"A belt of fine grey limestone at Gay's river corner carries a good percentage of argentiferous galena; it runs east and west and rests unconformably upon the lower quartzite group." . . . "This lower auriferous conglomerate is wholly composed of debris of the adjacent lower Cambrian rocks, apparently in an old river-bed, and rests on the lower graphitic ferruginous slate group. Beds of conglomerate similarly situated along the northern boundary of the gold-bearing rocks may prove sufficiently rich to be worked, but the great excitement caused two years ago by exaggerated reports of discoveries of gold in various places, remote from the gold-bearing rocks, have led a great many to take up valueless ground."

Dr. Gilpin also wrote in his Mines and Mineral Lands:—"At the mouth of the Shubenacadie river, the lowest visible carboniferous bed is a dark laminated limestone, which, with the overlying sandstones and marls, contains small veins holding limonite and specular ore, with ankerite, barite, calcite, goethite, manganite and siderite. In the same formation . . . at Clifton, similar ores are found." . . . "In Cape Breton, near McDougall's Point, Big Pond, a limited deposit of excellent quality was seen at the junction of carboniferous conglomerate with syenite; at McNeil's mill on the Glengarry road, similar traces have been met and large boulders occur at Loch Lomond post office."

On discussing this subject with Mr. Fletcher, he added: "I have no doubt about the lowest limestone being nearly always more or less mineralized, even when, as at Brierley brook and Washaback in Cape Breton it has a great thickness of the conglomerate beneath it. There seems to be always at this horizon a great unconformity. But in Nova Scotia proper I think no good deposits are found at the base of the conglomerate. It is not, however, well developed until you come to the Cobequid hills, after leaving Antigonish; and the Cobequid conglomerate is of doubtful age."

Suggestive as the foregoing extracts and comments are they fail to convey so clear an idea of the concentration of mineral deposition along the line of lower carbonifer-

[1] December, 1894.
[2] N. S. Instit. Trans. Vol. 17, p. 141. Ibid, Honeyman, p. 461.
[3] American Assoc. 1879.
[4] Mines and Mineral Lands of N. S., 1880, p. 65.
[5] Report of the Department of Mines, 1874, p. 55; for 1873, p. 35; for 1875, p. 64.
[6] N. S. Instit. Trans. Vol. II, p. 76.
[7] Report Department of Mines, 1877, p. 47.
[8] Geol. Sur. C. Rep. 1886, p. 162 P.
[9] G. S. C. Rep., 1876-77, p. 450.
[10] G. S. C. Rep., 1879-80, p. 122 F.
[11] G. S. C. Rep. for 1878-80, pp. 55 and 123 F.
[12] G. S. C. Rep. for 1882-83-84, p. 92 H.
[13] G. S. C. Rep. for 1886, p. 121 P.
[14] G. S. C. Rep. for 1889-90-91. Part P., p. 186. [15] P. 192.
[16] G. S. C. Summary Rep. 1893, p. 41. [17] P. 42. [18] P. 43.
[19] G. S. C. Summary Rep. 1890, p. 40.
[20] G. S. C. Rep. for 1889-91, p. 7, li. 3.

ous contact as a glance at a plan of any of the districts will do, and the accompanying outline maps of well known districts will illustrate the more forcibly the point it is desired to make. Sheet No. 1 shows the chief source of manganese in the County of Hants at many places along the line of contact. Where mines have been opened away from the contact they are in outliers of the carboniferous limestone that have been left in depressions of the older rocks out of the general course of the contact line. Much of the ore mined is of great purity and brings high prices, analyses of the various kinds and mention of the associate minerals, are given in How's Mineralogy of Nova Scotia, and in the Transactions of the Nova Scotia Institute of Science, and the mineral statistics published by the Geological Survey gives data between the years 1868 and 1882 of 4,560 tons of an invoice value of $117,831.00.

Sheet No. 2 is of the Stewiacke Valley where lower carboniferous rocks are flanked by upper Devonian on the north and lower cambrian on the south, deposits of barite, gypsum, iron, lead, copper and gold occurring along the contact. The iron near Brookfield is in the form of limonite, at Newton Mills it is as hematite. The gold lies on the lower cambrian in the basal bed of the carboniferous in washings of that age. The Gay's River gold mine has been regarded as workings in an ancient river-bed, but when it is considered that the auriferous conglomerate is apparently a deposit contemporary with the plaster and limestone resting also uncomformably on the cambrian, and they are unquestioned deep sea deposits, it seems more probable that the Gay's River auriferous conglomerate had a littoral origin similar to that of to-day at the ovens near Lunenburg. It may also be surmised that the section of country about Gay's River has been less elevated than that about Newton Mills. In the portion of the contact between Pembroke and Smithfield the mineral deposits along it are in the form of sulphides of iron, lead, copper, and zinc, a form which they also take on the south side of the valley five miles beyond the gold mine in Gay's River. Galena has been found on the surface and in prospect holes at other localities.[21]

Judge Morse speaks of lead ore having been sent about one hundred years ago from Cumberland County to Paris, and from it sufficient silver was extracted to make cups now in his possession. The source of this ore is not now known, but he thinks it may have been got near the head waters of Doherty's creek towards Wallace, where there is certainly lower carboniferous, but if it came from a deposit in contact with older rocks one would have to look towards Westchester.

In the County of Pictou the sulphides of iron, lead and copper are found infiltrating the tissues of plants scattered in permian strata, and in spots sufficient to induce prospecting from time to time, although the deposits are hopelessly valueless.

In the coal measures between the seams and even in veins cutting the coal, the sulphides of iron, lead and zinc occur in minute quantities.

There is yet another feature in connection with this mineral zone to be noted, and that is, the aggregation of some minerals about certain centres along the zone. In Hants County the contact carries both the oxides of manganese and iron, the former in greater abundance and in parts of exceptional purity, while in Pictou County where both are also present iron predominates, and although manganese is generally diffused it is only in spots concentrated enough for separation. In the Stewiacke Valley the iron ore there is believed to be free of manganese.

[21]Acad. Geol., p. 275; Reports Dept. of Mines; 1873, p. 35; 1874, p. 55; 1875, p. 63.

[22]G. S. C. Rep. for 1877-78, p. 24 F. Rep. for 1879-80, p. 123 F. Rep. for 1886, p. 122 P.

[23]Gilpin, Mines and Mineral Lands, p. 82.

[24]How's Mineralogy, p. 74.

In these notes it is not desired to convey an idea that mineral matter is absolutely confined to the contact, or that the contact is uniformly mineralized. Thin veins of ore do traverse the older series of rocks near the contact, but they have not been found to lead to deposits of value in them. In a search for ore along a contact the uncertainty of finding any may be largely reduced by confining operations to such portions of the contact as are touched by limestones of the carboniferous. Along the East river of Pictou it has been observed that where there are natural pits in the soil near the contact there is almost a sure promise of valuable deposits of limonite, the natural depressions being indicative of limestone beneath. A similar experience, it is understood, has been acquired at Tenny Cape in the manganese mines; and the same may be expected in the galena district of the Stewiacke valley, although explorations have been as yet too limited to speak positively.

To the prospector this information should be of very great importance, for next to knowing where to go it is well to know where not to go in search of metallic minerals. But in the use of the geological maps some caution should be exercised; it should be remembered that these maps are not complete, that the facilities placed at the service of the Survey have not enabled the officers to trace with unerring exactitude the actual line of contact at all points and this incompleteness is indicated by broken or open dotted lines on the maps. And further the prospector should not entirely ignore the finding of "float" ore away from the line until he has satisfied himself that it does not come from an outlier of the carboniferous limestone, similar to those at the Parker and Whale creek manganese mines; or perhaps the converse condition, from a limestone resting on a boss of the older rock protruding through the newer series well within the line of contact.

To repeat the conclusion reached, it may be said that while ores of value occur both in beds and in veins through older formations, in the lower carboniferous it may be accepted as proved that deposits worth working are only to be found in the basal beds and at the contact with older rocks, with a strong probability that they are exclusively confined to the basal limestone.

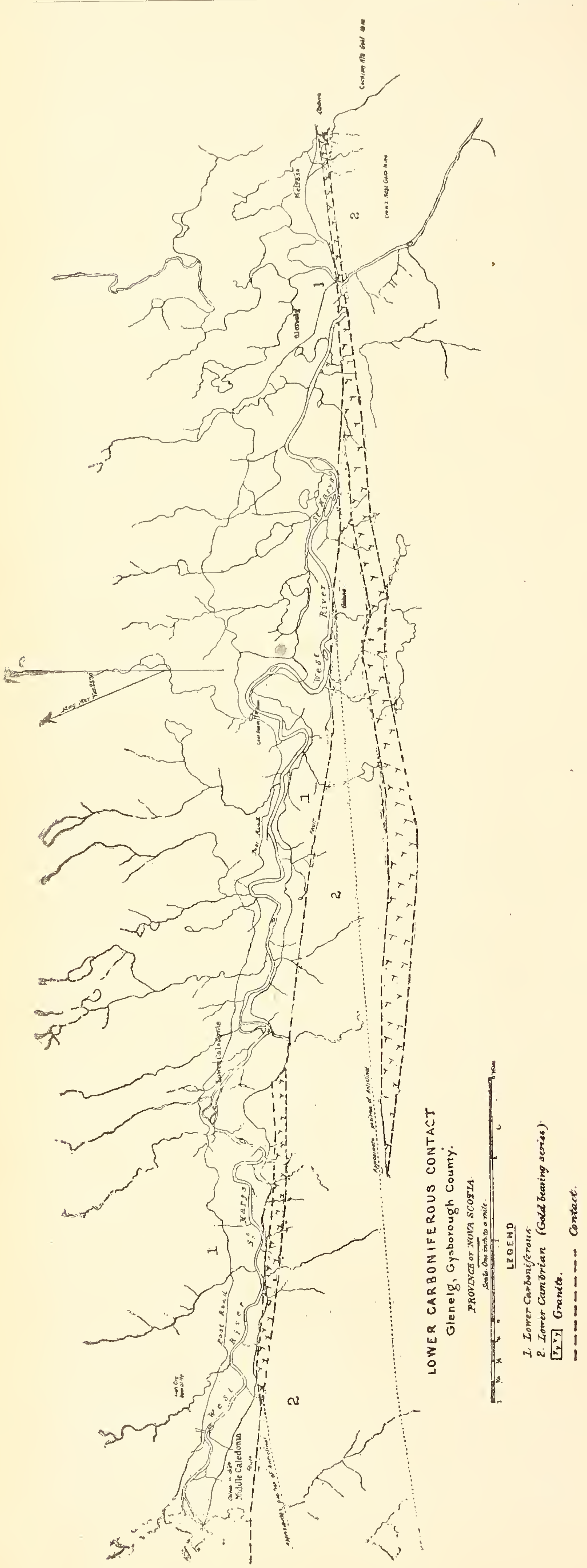
The experience here given as exclusively Nova Scotian, seems also applicable to the Magdalen Islands where manganese ores also occur in lower carboniferous limestone at the contact with brecciated red sandstones and shales probably of Devonian age.

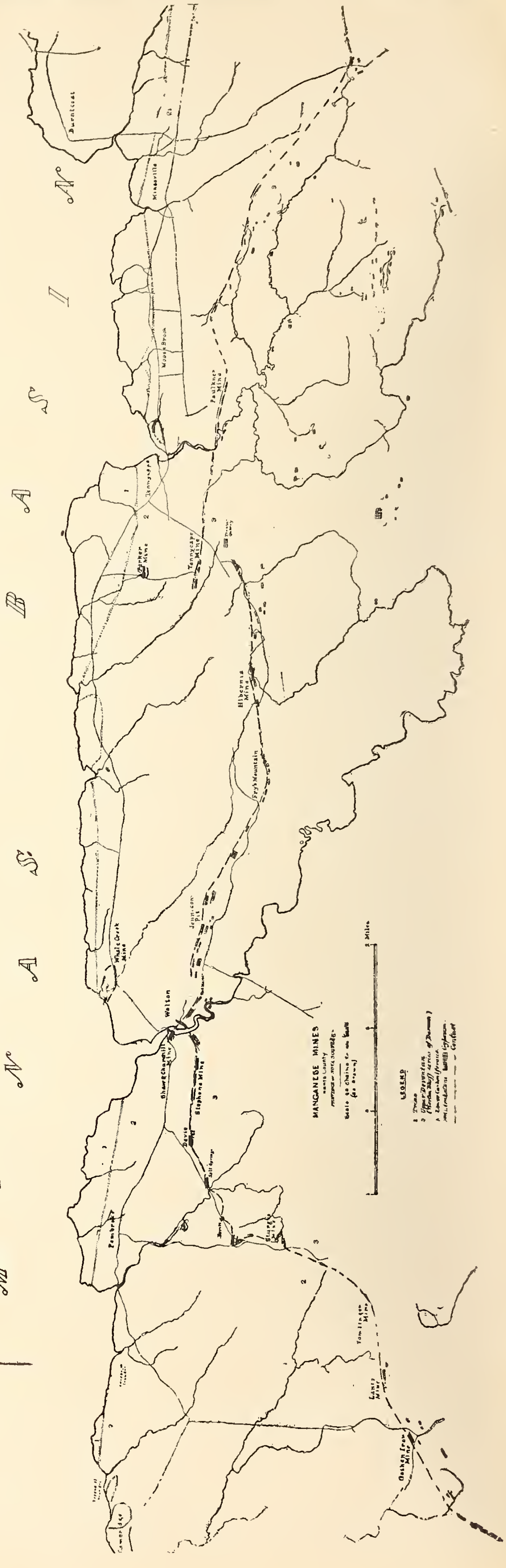
DISCUSSION.

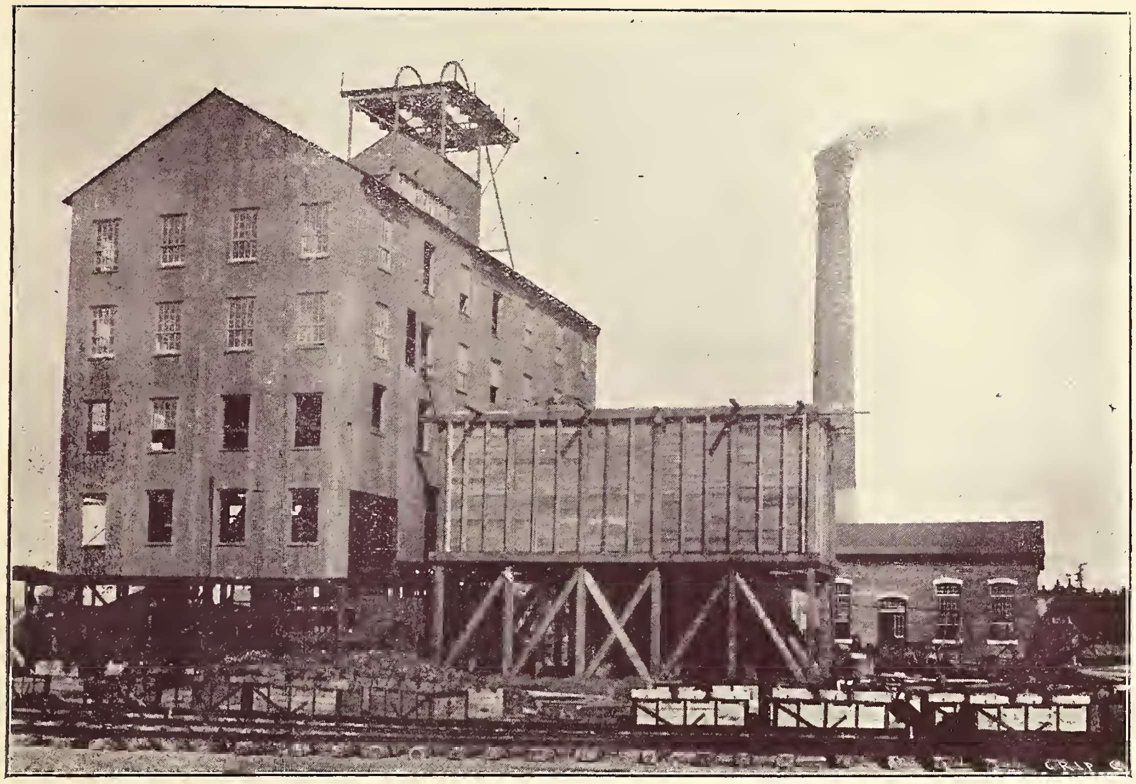
Mr. R. G. Leckie—I regret very much that I have had time only to give a very hurried reading to Mr. Poole's excellent paper. It must prove of much practical value to those engaged in exploration for mineral deposits and to those charged with their development.

The Devonian formation in many parts of the world is rich in a variety of minerals of immense importance, notably in Somersetshire, England. Near its contact with the lower carboniferous in the Mendip and Brendon Hills extensive deposits of iron ores, both spathic and limonite have been long worked and lead ores are said to have been raised there before the advent of the Romans. In Derbyshire and Cumberland both lead and iron ores occur in considerable abundance in these formations, and also in the Upper Ward of Lanarkshire at Leadhills.

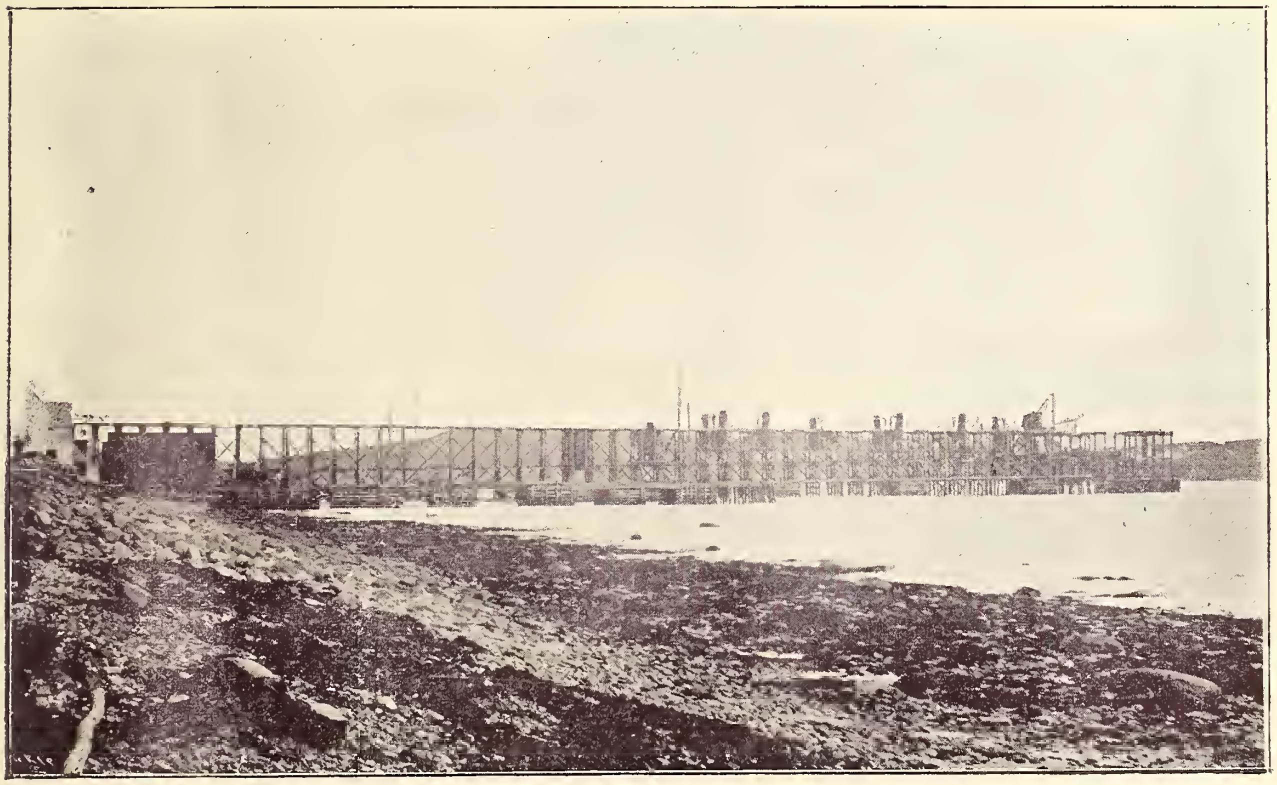
In this Province extensive deposits of iron ores are traced continuously for many miles in the geological horizons to which Mr. Poole calls attention. The great deposits worked at Acadia mines are met with in the upper portion of the Devonian, and within a few hundred yards ot its contact with the lower carboniferous. Indeed, at East mines a coal seam, much faulted and broken, was opened within four hundred yards of the iron ore, but by an overturn it dips towards the Devonian and is soon cut off.


LOWER CARBONIFEROUS CONTACT
Glenelg, Gysborough County.
PROVINCE OF NOVA SCOTIA.
Scale One inch to a mile.
LEGEND
1. Lower Carboniferous.
2. Lower Cambrian (Gold bearing series)
Granite.
Contact.
West River
St. Marys
Post Road


M I N A S B A S I N
MANGANESE MINES
LEGEND
Walton



DOMINION COAL CO. Ltd.—DOMINION No. I COLLIERY CAPE BRETON.



DOMINION COAL CO. Ltd.—NEW SHIPPING PIER AT LOUISBURG, CAPE BRETON.

operator of the Ingersoll machine weighed 220 pounds; the operator of the Yoch, 200; and the operator of the Harrison only 150.

like to ask Mr. Blakemore what he would allow for cost of plant, interest on machinery, wear and tear, etc.

From below Economy in Colchester County eastwardly to the Pictou line, the limonite and spathic ore can be traced with much regularity, preserving a distance of about 300 yards from the contact of the two formations. On the opposite side of the Bay of Fundy the limonites found at Old Barnes, Selma and Goshen, appear to be confined to the lower carboniferous limestones, but near the Devonian slates and sandstones, but the red hematite of Big Pond, Cape Breton County, is apparently a contact vein of very irregular width.

An irregular deposit of manganiferous iron associated with gypsum occurs at Doherty Creek, Cumberland County, at the base of the carboniferous limestone.

The extensive beds of magnetites and hematites in Annapolis County, stretching from the Kings County line to Clements Port, passing through Torbrook and Nictaux, are from their numerous fossils, evidently of upper Devonian age, but the carboniferous has not yet been found in this locality, so far as I am aware.

The marvellous auriferous deposits of the Transvaal are not veins, but extensive and regular beds of fine conglomerate. I do not know to what geological horizon these beds have been relegated by local geologists, but coal is worked at no great distance from the gold mines, and it may be that these conglomerate beds occur at or near the contact of the two formations to which Mr. Poole so ably and practically calls attention.

The Capacities of Coal Cutting Machines.

By W. Blakemore, M.E.

The subject of coal cutting by machinery has become increasingly important during the last few years, both by reason of keener competition in the production of coal, and in consequence of serious disturbances in the labor market. Inventors and manufacturers have exercised much ingenuity, and expended large sums of money in endeavoring to produce a machine which, on practical and economic grounds, would enable the colliery proprietor to increase the yield of his mine without additional manual labor, and at the same time, if possible, to reduce the cost of production. The result achieved has undoubtedly been a success regarded from the standpoint of practicability. Machines are in the market which are adapted to all kinds of coal cutting, which can easily be handled by the workmen, and which in the hands of an average cutter will yield an increased tonnage, beyond what it is possible to procure by hand cutting, fully proportionate to the reasonable expectations of the mine owner, and the claims of the manufacturer.

The other question, as to the economic result, requires more careful handling, because there are important considerations outside the mere question of coal cutting, which have a bearing upon the subject, and which must be taken into account before it is possible to arrive at a final conclusion in the matter.

I have recently had an opportunity of conducting a careful test trial of three machines, under conditions which precluded the possibility of any unfairness or partiality, as the trial was made under the control of the officials of the Dominion Coal Company, who had no interest to serve except to ascertain the capacity of the several machines; and while I wish at once to disclaim the reliability of a test run as affording any criterion of the actual amount of work which can be expected under ordinary circumstances, it is none the less interesting and reliable as illustrating the relative values of the machines, and the maximum amount of work which they will perform under given conditions. The trial took place in the Dominion No. 1 mine of the above company, and extended from the 29th of July until the 10th of August. The cutting was done in the Phalen seam, which is about 8 feet thick, and a fairly strong semi-bituminous coal. The roof is a silicious rock bine, and the floor a strong dark batt. The seam lies at an inclination of 1 in 14. The system of working is pillar and room, with the rooms advancing on the full face of the coal, and almost on the crop. Three machines were used, the Ingersoll, the Yoch, and the Harrison. The conditions were that each machine should be worked by the same runner for the whole of the test, that each runner should be allowed a helper to shovel away the coal and to assist him in moving the machine from room to room, but that the helper should not be allowed to touch the machine whilst it was in operation. The compressed air which worked the machine was turned on every night at seven, and turned off every morning at four, the cutting all being done at night to furnish an opportunity of taking away the coal in the day-time. The Ingersoll and Harrison machines were moved from room to room by the cutter and his helper; the Yoch machine, being heavier, was by arrangement moved around by the help of a horse and driver. In order to give the full particulars of the machines, their dimensions, weight, etc., I now append tabulated statement No. 1.

DESCRIPTION OF MACHINES IN DOMINION NO. 1 MINE.

No.	Name.	Diameter of Cylinder.	Length of Stroke.	No. of Strokes per Minute.	Working Pressure in Lbs.	Weight.
1	Ingersoll....	4 in.	11 in.	200	80	750 lbs.
2	Yoch.......	6 "	14 "	120	80	1,100 "
3	Harrison....	3¾ "	12 "	200	70	700 "

No. 2 statement shows the amount of work done on each shift during the fortnight that the trial lasted, and from the summary you will notice that in the eleven working days a total 5,635 square feet were under-cut, being an average per day for each machine of 509, and an average per hour for each machine of 57.30, and that they produced during that time a total tonnage of coal equal to 4,460, being an average daily of 403 for three machines, or 134 for each machine. This, so far as I know, establishes a record in this class of coal. To give a clearer idea of the work done I may say that as the rooms were 20 feet wide, it represented the under-cutting of about five rooms each shift, the depth of under-cutting being 5 feet. Two of the machines, the Ingersoll and the Yoch, worked very evenly all through, and at the finish the difference was not considerable; about 10 square feet per day in favor of the Ingersoll. The Harrison was far behind, averaging only 440 feet per day, as against 549 and 539 respectively for the Ingersoll and Yoch; but it is only fair to say that this difference does not represent the actual difference in the merit of the machines, because the Harrison was unfortunately hampered with defective valves, which have since been remedied; and was also worked by a much smaller and lighter man, and while I do not think that a moderate difference in this respect would materially affect the result, I do think that the difference in this case was sufficiently considerable to do so. I may say that the operator of the Ingersoll machine weighed 220 pounds; the operator of the Yoch, 200; and the operator of the Harrison only 150.

To compare the result achieved by these machines with the work done by an ordinary coal cutter with a pick shows a considerable difference; for where—as in the test under consideration—the machines averaged 134 tons per day, a pair of cutters, who load their own coal, would produce in the same seam about twelve tons per day; but, assuming that the process of loading represents half the labor (an excessive estimate), their cutting could not be taken to represent more than twenty-four tons, which is between a fifth and a sixth of the work done by each of the machines. It must not, however, be forgotten that whereas the man who cuts the coal by hand carries all his paraphernalia with him, walks into his working place, cuts and loads his coal, and goes away without any further trouble; the man who cuts by machinery requires a great deal of attention both before and after the process, the sharpening of picks, constant attention and frequent repairs to a machine, piping up of rooms every day as the work progresses, in addition to the great question of motive power.

After carefully watching the test, and summarizing the results, I came to the conclusion that the machines had done all that we had expected of them, and had fairly demonstrated that under the conditions that existed in Dominion No. 1 mine they were capable of producing a larger tonnage of coal in a given time, and at less cost, than by any other method with which I am acquainted. The advantages are apparent, viz., more rapid development of the mine, and procuring a larger output in a shorter time than would be possible by hand labor. The restricted area of workings to produce a given output, and consequently an important saving in the maintenance of roads, air ways, and working places. Greater resources for producing coal in an emergency; and in a well equipped mine, an undoubted saving in the cost of production. On the other hand, it must not be forgotten that this paper deals exclusively with coal cutting machines and their work, and we must not forget that before this work can be done a large expenditure is necessary in providing motive power and conducting it to the working places; and it is not until the cost of supplying this, together with the cost of maintenance, and a fair allowance for depreciation of plant and machinery has been added to the cost of mining, that we are able to compare it with the labor method.

I think it may be interesting to refer to the subject again in the future, as I shall no doubt be in a position to speak more definitely in the course of a year or so.

Dominion No. 1 mine is laid out to be worked entirely by machinery, and no coal is cut by hand. It will be therefore much more reliable to refer to the working cost after a longer experience, than to base opinions upon a trial test; but I may say that while the ordinary work has fallen below the test above referred to, the net result has been to confirm the practicability and economy of cutting coal by machinery.

STATEMENT No. 2.

DOMINION. NO. 1.

	INGERSOLL				YOCH				HARRISON.			
July & Aug.	Rooms	Cuts.	Sq. ft.	Hours.	Rooms	Cuts.	Sq. ft.	Hours.	Rooms	Cuts.	Sq. ft.	Hours.
29....	4	1	504	7½	4	2	540	9	4	—	470	9
30....	4	2	571	8½	4	1	509	9	4	—	402	9
31....	4	2	558	8½	3	2	467	9	4	—	417	9
1....	4½	1	535	9	4½	1	638	9	4	—	425	9
2...	4½	1	574	9	4½	—	524	8½	4	—	411	9
3....	3	—	332	5	3	—	351	5.	2	—	231	5
5...	4	3	565	9	4½	—	486	9	4	—	441	9
6....	5	—	537	9	4	—	463	9	4	—	460	9
7....	5	—	541	8½	5	—	538	9	4	—	450	8½
8....	5	—	477	9	5	—	543	8½	4	1	578	9
9....	5	—	523	9	4	1	508	9	4	—	447	8½
10....	3	—	321	5	3½	—	362	5	3	—	268	5
	51	10	6038	97	49	7	5929	99	45	1	4940	99

(Only worked from 7 a.m. till 12 a.m. Saturdays.)

SUMMARY.

Machine.	Sq. ft. Cut.	Full days.	Sq. ft. per day	Hrs. work'd	Sq. ft. per hour.
Ingersoll..........	6038	11	549	97	62.24
Yoch.............	5929	11	539	99	59.88
Harrison....	4940	11	440	99	49.89
Total.......	16907	33	1528	295	172.01
Average....	5635	11	509	98	57.30

COAL CUT.

Machine.	Total tons.	Tons per day.
Ingersoll....	1627	147
Yoch....	1557	141
Harrison....	1276	115
Total....	4460	403
Average....	....	134

[At the request of Mr. Blakemore, Statement No. 3 is withheld.—Editor.

DISCUSSION.

Mr. FERGIE—The paper is a most interesting and instructive one. I would like to ask Mr. Blakemore what he would allow for cost of plant, interest on machinery, wear and tear, etc.

MR. BLAKEMORE—I will be happy to reply to all questions, and will note each one as it is asked and answer them later on.

MR. BROWN—What is the width of the rooms you are driving?

MR. BLAKEMORE—Twenty feet. The actual cost of the powder was $1.60, 5 tons of coal to every pound of powder.

MR. BROWN—At Sydney we produce 6 and 7 tons to a pound of powder.

MR. BLAKEMORE—I would not regard the consumption of powder on that occasion as a criterion. The cost of shot firing was excessive.

MR. DICK—Was the coal screened? How about the size?

MR. BLAKEMORE—I will give you that later.

MR. ROBB—Would the machine require to be repaired very frequently during the progress of the test?

MR. BLAKEMORE—No repairs were done on any of the three machines during the test. They were not damaged or appreciably worn.

MR. DICK (Halifax)—Was the floor even? What about an undulating floor?

MR. BROWN—Was the floor hard or soft?

MR. DICK (Halifax)—Has any test of the three machines been made worked by the same man?

MR. BLAKEMORE—Yes.

MR. DICK (Halifax)—What was the difference in the amount of coal undercutting with the machine and compared with hand labor? Does the machine waste any more coal?

MR. BLAKEMORE—I will deal with that.

MR. FERGIE—You stated that less pit room was required for the machine. Does it not require two rooms for each machine? Do you not prepare the coal one day in one room, and go at the next while it is being prepared?

MR. BLAKEMORE—In all mines the output depends upon the cutting of the coal. Where you have a machine producing five times as much in a given time as a man it would be a question of employing more men to load, blast and produce your coal in a small place.

The first question asked by Mr. Fergie is in reference to the cost of the motive power and depreciation of plant. The expenditure on plant is elastic and depends upon the ideas of the engineer. I may say, however, that the result of our experience for nine months work on this system would lead us to add about ten cents to the ton to cover cost of maintenance of plant, pipe ways, repairs to machines and pipes, flexible hose, depreciation, and interest on cost. As to that test I may say that we could not get as much coal in ordinary working and the cost would therefore be higher. What I have said as to the ten cents, however, would be perfectly safe. When you have added that to the other items given, the cost is below what you can possibly do it for by hand.

As to the percentage of coal and slack, our figures show that we cut a larger percentage of round coal than by hand. We did not at first because we did not give them the same chance as now. There is no difference in the coal brought down. Your saving will be in the undercut. A man by handpick will take 18 to 20 inches on the face, and with the machine you can do with 12 or 14 inches. After taking 14 inches off the face you follow down to a narrow groove. At the back of the cutting you only have 3 to 4 inches. In the case of hand labor you must leave a larger space. You get five per cent. more coal with the machine than you do by hand.

As to the inequalities of the floor. A man cutting by hand can humor his work to the inequalities of the floor. You do not do that with the machine. You are obliged to leave coal on the floor equal to the height of the swell. That has to be taken up by hand. That, however, only means a few inches.

I have been asked as to one man running the three machines. I cannot settle their merit beyond what I have told you. I think I may say, however, that there is very little to choose between the three. We have had as much coal cut by the one as by either of the other two when the same man worked the machine. The Yoch machine, which is the heavier one and has the larger cylinder, is no doubt better adapted to very hard seams than either of the others.

There are just three other points of interest that you might like to hear about. You might ask how the men received these machines. Of course at first they did not receive them with open arms. I recollect the Right Hon. Jos. Chamberlain once made a remark that he had never known a machine introduced in any trade, and which was opposed by the workmen, which in the end was not beneficial. In the first instance we had to bring outsiders to work them. Now we can get better average results with our own men than we did with the experts who came down to work them. No man will go back to hand labor who can get a machine. The machine looks too big for a man to handle, but I believe it is not so hard on the man as cutting by handpick, which is laborious work, as each bit has to be cut out. With the machine he can be in a sense resting part of the time. The machine is fixed on a board sloping towards the face, 700 pounds on an inclined plane. Then you have your motive power, and the effect is to draw the machine back and the weight of the m chine reasserts itself. He has only to guide the machine and just to aim it at the point which will the more readily break down his coal. When he has learned to steer it properly it is not so laborious as hand labor. Another thing to make it popular is the fact that a man can earn more money by it. Men who were getting with the hand-picks an average of $2.00 to $2.50 per day are getting with the machine from $3.00 to $3.50 and $4.00, and as high as $5.00 per day. In the face of that you cannot wonder that there is no further opposition to the machine.

As to its utility in regard to ventilation. You cannot ventilate the mine with it, but the escape of free air from it is a help to ventilation. In driving a heading the escape of air helps to keep the face sweet and free from gas. We are still using the longwall machine. We have not done any better than when the former test was made. We once cut 500 lineal feet on the face and 3 feet undercut in a day's run of eight hours with it as a trial test. It now averages per day about 200 lineal feet on the face with a 5 feet undercut.

At the conclusion of that test we talked about what would be a fair price. We agreed to assume the basis of half the work done during the test, and upon that basis a price was fixed. We find that any of the men can do about half the amount of work that was done in that test.

MR. DICK—What is the steepest up-hill grade you have worked against?

MR. BLAKEMORE—One in twelve. It is a question whether it could be worked at 30 degrees. It is certain that you could use it on steeper grades than 1 in 12 by elevating your tail-board.

Lignite Briquettes.—The manfacture of lignite briquettes is becoming a considerable industry in Germany. The first briquette plant in the Rhenish district was established at the Rodder mines, near Bruhl, in 1876. At the present time in the Vorgeberge district, including the one at Herzogenrath, there are 15 briquette-making establishments, with 50 presses in operation, the annual output amounting to about 550,000 tons.

MICA MINERS IN SESSION.

Further Discussion on Standard Grades and Prices for Canadian Mica.

The adjourned meeting of owners of mica property and producers of Canadian mica was held under the auspices of the General Mining Association of the Province of Quebec, in the Russell House, Ottawa, on Wednesday afternoon, 11th December.

There was a representative attendance of miners, Mr. T. G. Coursolles (Wallingford Mica Co.) in the chair.

MR. B. T. A. BELL, (Ottawa) moved the adoption of the following resolution: Resolved that the mica miners and owners of mica property in Canada form a section of the General Mining Association of the Province of Quebec, to be known as the Mica Section, and that this section be represented by a chairman, secretary, and an executive of five.

He did not think it wise to organize a separate organization when a representative organization such as the General Mining Association already existed, and many of the mica miners were already members of it. The Association was distinctly protective in its character, and had, as most of them were aware, exerted during the five years of its existence, a very beneficial influence in promoting good laws and in extending a knowledge of the value of the resources of the country. They all remembered the pernicious influence of the Mercier Mining law, and the tax on powder magazines. Even at this moment there were clauses in the mining law, which, although inoperative, might be put into force by the administration at any moment with serious consequences to the investment in mines. He instanced the clause regarding royalty.

MR. MORRIS—What clause is that?

MR. BELL—Sec. 1435, by which the Government may, if it thinks proper, claim at any time the royalty due to the Crown "upon any land already sold, conceded or otherwise alienated by the Crown or which may be hereafter sold, but only five years after the date of such alienation." The royalty did not exceed 3 per cent. at the mine after deducting the cost of extraction. While they had the assurance of the present commissioner, the Hon. Mr. Flynn, a gentleman who had shown himself to be alive to the necessity of encouraging the mineral industries, that the royalty would not be collected, it was imperative in the interests of mining that it should be wiped out of the statute books, and he had no doubt that efforts would be made by the Association to secure this at an early date.

MR. W. F. POWELL—That is one reason why everyone should join the Association.

MR. M. MORRIS—I agree it would be a very good thing.

MR. BELL (in answer to questions)—Our Association was formed in 1891 and has held altogether about 20 meetings. The membership at present includes representatives of every mining company. The annual subscription is ten dollars.

MR. G. S. DAVISON (Vavasour Mining Association) seconded the resolution.

MR. G. S. MACFARLANE—It would be well to ascertain how many would become members.

MR. BELL—That is immaterial just now as the principal producers are already members.

After some further discussion the resolution was put to the meeting and carried.

MR. LEWIS McLAURIN (Templeton), seconded by Mr. W. F. Powell, moved that the standard grade for Canadian mica, rough, split and edge-trimmed, be 1 x 3 in. to 2 x 4 in., 2 x 4 in. to 3 x 6 in., 3 x 6 in. to 4 x 7 in., and 4 x 7 in. upwards.

MR. COURSOLLE (Wallingford Mica Co.)—Do you think the first grade should be 1 x 3 in. to 2 x 4 in.?

MR. H. C. BAKER (Templeton)—I think that is the proper grade.

MR. WALLINGFORD (Templeton)—There is only one company using 1 x 3 in. and I do not think it would be advisable to mix it with 2 x 4 in. I think the grade should be 1 x 3 in. to 2 x 3 in. and 2 x 3 in. to 2 x 5. There is no demand for 1 x 3 in.

MR. McLAURIN—If you want to get rid of your 1 x 3 in. put it in with the 2 x 4 in. The closer together the sizes are the harder it is to grade. 1 x 3 in. to 2 x 4 in. is about as close as you want to get. 1 x 3 in. to 2 x 3 in. is very close for a man to grade by eye and if you put 1 x 3 in. to 2 x 3 in. alone it will be always left on your hands. The reason is that people are selling larger stuff at nearly the same price.

MR. WALLINGFORD—I have offered 1 x 3 in. mica closely trimmed, as good as could be produced in Canada, and offered it for mostly anything, and consumers would not have it at any price. There is only one company I know of that is using it, that is the Westinghouse Co., and they could not use half what is in the country today. I do not think it would be advisable to put 2 x 4 in. with 1 x 3 in. It would be better to throw the 1 x 3 in. away. It is not worth handling, not worth trimming.

MR. BAKER—I do not know about 1 x 3 in., but I have sold quite a lot of 1½ x 2½ in., quite a quantity; and that was not to the Westinghouse Company.

MR. COURSOLLES—We have sold 1 x 3 in. too, but not lately.

MR. BAKER—The only question is whether we should try to make them take 1 x 3 in.?

MR. COURSOLLES—Can you force the buyers to take 1 x 3 in. in any shape?

MR. WALLINGFORD—I do not think they would take it. It would only be in a case where there was no mica in the country.

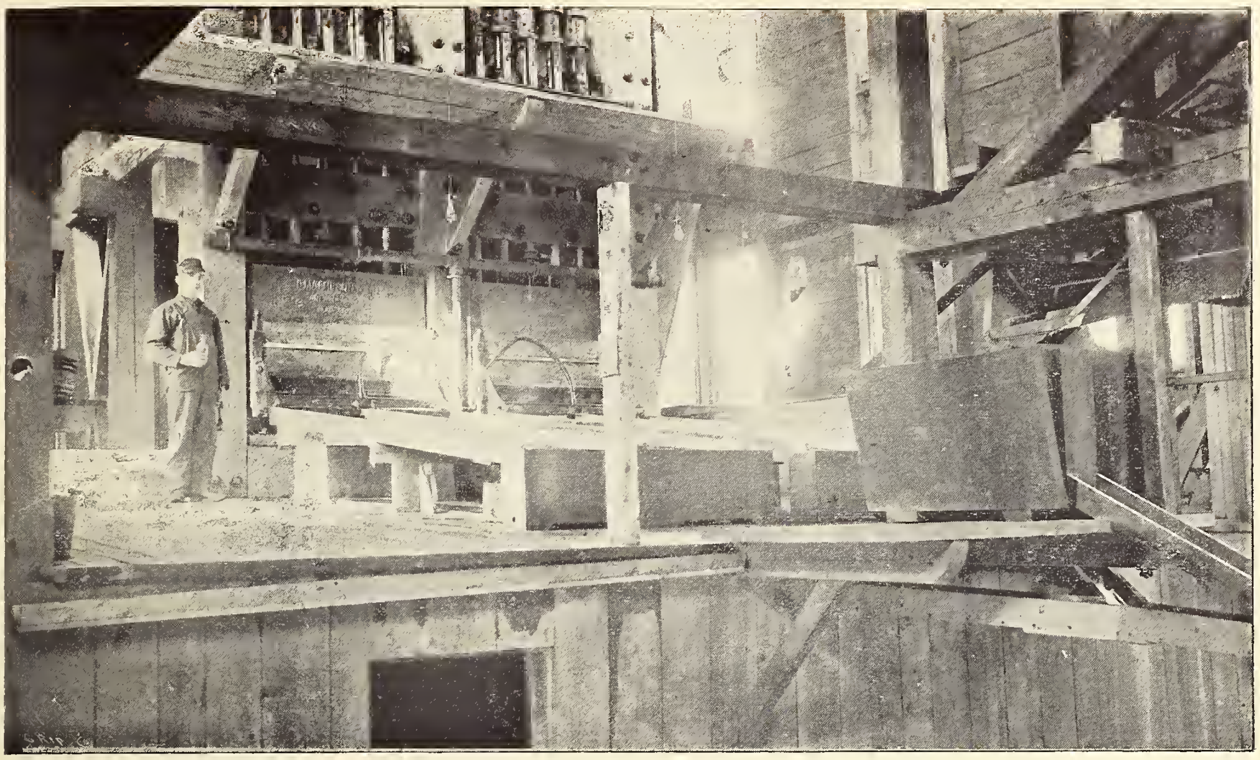
MR. G. S. DAVISON—Here are the men producing the mica. Our grades are 1 x 3 in. to 2 x 4 in. and we are all resolved to stick by them. It is not for you to say "We will take so and so," it is for us to say what you will take. Make your other mica sell the 1 x 3 in. If all will stand together and say here are our grades, it will give us the advantage. Put up all our 1 x 3 in. to 2 x 4 in. and stamp it, and the next grade the same way, ready to sell.

MR. WALLINGFORD—They would not call for it, if you have larger mica. What about a piece of 3 x 3 in., where would that go? It would not go into 2 x 4 in.

MR. DAVISON—You do not want to mine a pound of stuff for nothing.

MR. BAKER—Taking Mr. Wallingford's side of the question: If you leave out the 1 x 3 in. you can get a higher price for the 2 x 3 in.

MR. DAVISON—You go to work and mine a greater amount of 1 x 3 in., for which you get nothing. You produce a big amount of mica for which you have no sale. You must make something by increasing prices of the smaller grades. If you put in the 1 x 3 in. you work off all your small mica.



CARIBOU GOLD CO.—INTERIOR OF TEN STAMP MILL.

CARIBOU GOLD CO.—MILL AND SHAFT HOUSE.

Mr. WALLINGFORD—If a consumer sends an order for 50 pounds of 2 x 4 in. could you send him 50 pounds of 2 x 3 in.

Mr. BAKER—If he knows our grades are 1 x 3 in. to 2 x 4 in., he will have to send an order for so many pounds of that grade. If he does not like it let him pay the price for a higher grade.

Mr. COURSOLLES—It would be hard to force consumers to take what they cannot use. It is the same with all kinds of goods. You go to a merchant and he offers you all sorts of cottons at different prices and you take what you want.

Mr. DAVISON—But he has some half a yard wide, some a yard wide and so on for all standard widths. We want standard sizes for mica.

Mr. COURSOLLES—What do you intend by grades? Do you sell by such grades or by the ton?

Mr. DAVISON—To sell in quantity not less than a ton lot. We have four grades, and in an order for five tons 2x4 in. to 3x6 in. the buyer must take so much 1x3 in. to 2x4 in. and he pays the price fixed by the producers. When you have it laid down that these are the grades in which you put up the mica to be sold in large lots the public will very soon appreciate the fact. If they come to any mica producer he will say, here are our prices and grades. If the man says I want 1x4 in. to 4x6 in. he will be told we have 1x3 in. to 2x4 in., etc., how much of each do you want. He pays for the proportion of each grade he takes. The thing is not unreasonable, and having the grade settled it facilitates packing.

Mr. WALLINGFORD—Have you got any experience in the 2x4 in. grade? A man who has not a very rich mine does not go beyond that and you can get just as much for 2x3 in. as for 2x4 in. It is a long jump from 2x4 in. to 3x6 in. Instead of making two sizes in 2x4 in. we are making one size. That mica which does not cut 1x3 in. is of not much account. What we want to find out is your view on the 2x4 in. It is a long jump from 2x4 in. to 3x6 in. I am ready to back you in this idea but you will find out it is to your disadvantage to grade in that way. My idea of the grades is this:— 1x3 in. to 2x3 in., 2x3 in. to 2x5 in., 2x5 to 4x6 in., and 4x6 in. up.

Mr. WALLINGFORD then put his ideas in the form of a motion which was seconded by Mr. Powell, as follows:— That the grades of mica be 1x3 in. to 2x4 in., 2x3 to 3x5 in., 3x5 to 4x6 in., 4x6 to 5x7 in., and 5x7 upwards.

Mr. BAKER—Before the question comes to a vote we must not lose sight of the fact that this meeting was called to prevent the consumers dictating to us how we should put up our mica. If we agree with them and put up the sizes they say they want we are coming back to the same old thing and not getting rid of our 1x3 in. at all. When we met here it was with the idea that we should dictate to the consumers. If we fix our grades to suit them they are dictating to us.

Mr. WALLINGFORD—We are selling to our best advantage.

Mr. BELL—We have heard both sides of the question. I would suggest that the best plan now is to put the motion and amendment to a vote and whichever is adopted let that be the standard grade, draw up an agreement for signature by every producer and have that agreement sent out by the Secretary to the trade as the standard grades of Canadian mica. If you decide upon grades it must be understood that each producer binds himself to that grade.

Mr. COURSOLLES—These grades should be only by the ton. It is quite understood that if consumers want other grades they will have to pay higher prices of course. The question of price comes in and we must set a minimum price from the 1x3 in. for all grades included for a ton of mica and other prices for separate grades.

Mr. MACFARLANE—You might get an order for half a ton and then another for the same quantity, and so forth.

Mr. DAVISON—It will prevent peddling orders.

Mr. WALLINGFORD—If they do not want 1x3 in., sell them 2x4 in. and ask a better price.

Mr. POWELL—We have got to consider the large quantities of small mica that are really the run of the mine. The large sizes are not so important.

Mr. E. D. INGALL—If you do manage to make consumers take this small stuff, having it on their hands, they will hustle to make a use for it. If you can manage to make them take a proportion of it, it is quite possible they will find uses for it.

Mr. WALLINGFORD—Any mine at all can produce 1x3 in. and in time it would cut the price of bigger mica.

Mr. INGALL—I refer, of course, only to new uses which will no doubt be found.

The resolution, as amended by Messrs. Wallingford and Powell, was then put and carried.

Mr. BELL—I move that this resolution be embodied in the form of an agreement, and that the Secretary be instructed to see that every one signs it, and send the resolution of this meeting to the principal consumers of mica in the United States and Europe.

Mr. POWELL—I have much pleasure in seconding that.

The motion was put and carried.

Mr. COURSOLLES—What about prices?

Mr. BELL—That is a question which cannot be settled now.

Mr. WALLINGFORD—What advantage will it be if we agree on grades and not on prices? If everybody is going to sell at his own price and not let anybody know there is no use in organizing at all.

Mr. BELL—Let us leave the question of a minimum price for standard grades to be considered by a small committee. I would move that Messrs. Edward Wallingford, L. K. McLaurin, Mr. Blackburn or Mr. Baker, Mr. T. J. Watters and Mr. Davison, be a committee to consider the price for the grades that have been adopted; the committee to report to an early meeting of the Mica Section.—Carried.

It was resolved that this committee meet on Wednesday afternoon, 18th Dec.

The meeting then adjourned.

MEETING OF THE COMMITTEE.

At a meeting of the committee held on Wednesday afternoon, the 18th instant, in the Russell House, Ottawa, Mr. T. G. Coursolles in the chair, a minimum standard of prices for the standard grades was drawn up.

A Coal-Unloading Device.—Descriptions and illustrations are current among our contemporaries of the long coal-car dumping machine, which has been erected by the Excelsior Ironworks Company, of Cleveland, and which is stated to have unloaded three ordinary cars of lump coal into a vessel in 3 minutes. The apparatus consists of a hollow cylindrical riveted steel frame, into which a car is run on a switch. The car is rigidly held by hydraulic clamps and the cylinder is rolled over half the circumference 180° around its horizontal axis, so as to invert the car and discharge its contents into a horizontal chute. Then the cylinder is rolled back into its original position in line with the delivery track, and while the car is withdrawn and another one placed in it the chute is lowered and gently delivers the coal into the vessel's hold. Both the cylinder and chutes are operated by wire ropes, and the simple mechanism is actuated by an engine taking steam at 80 lb., and requiring the services of only three men altogether.

CORRESPONDENCE.

The Dominion Smelting and Refining Co.

To the Editor:

Sir,—Among the Nova Scotia mining notes sent in by your correspondent and published in the November issue of the Review is one referring to the winding up of the Dominion Smelting and Refining Co., which calls for notice from me, as I have been acting as consulting engineer for that company.

Your correspondent is badly misinformed as to facts and woefully rash in his conclusions.

What I did state in my report to the directors under the date of Oct. 25th was as follows:

"I am not willing to ask you to recommend further work to the shareholders as the result of the work hitherto done is so unfavorable. There are equal chances that further exploration and boring would discover a larger and better deposit than has yet been met with, but *under the agreement to which the shareholders subscribed*, it is for them to decide." (The agreement referred to requires the assent of two-thirds of the shareholders before further calls upon the stock subscribed can be made.) In arriving at "this conclusion" less than $1,000 was expended under my direction, the other $4,000 had been expended before I was called to the Board of Directors.

Because, in a report of Dr. Gilpin's, made at a time when the largest and richest pocket of ore yet found had just been taken out, it was stated that, by estimation and without test, the ore shown might average 15 per cent. of galena (which means about 12 per cent. metallic lead), your correspondent *assumes* the "large body" still in existence and *in situ*; and proceeds to indicate the proper metallurgical plant for initiatory proceedings.

If your correspondent had gone over the Smithfield property at any time during the last two years, with his eyes open, his mind in a receptive condition and Capt. Evans' report in his hand, he would in all probability have said what several shareholders (who were "practical miners") have said in my hearing, "Where is all this ore that Evans saw?" or, "did he ever see it?"

As to your correspondent's insinuation that the company would have fared better if they hed secured a "practical lead miner" instead of myself, I can only say it is quite possible.

I am a little at a loss to know the difference between a "practical miner" and a theoretical one in this connection, but doubtless that is due to the same stupidity on my part which your correspondent seems to think has led to the winding up of the Dominion S. and R. Co.

I am,
Yours, etc.,
J. E. HARDMAN.

Montreal, 7th December, 1895.

Gold Mining at Trail Creek, B.C.

To The Editor:

Sir,—Perhaps the following notes respecting mining in this district may be of interest to your readers.

The Le Roi mine was the first location made here in 1890, and samples of ore from it were at first rejected as being too low in value to be worked with profit. Nevertheless the owner, after several attempts, sold to a Mr. Durant who, in turn, organized a company and commenced work with only a pack trail for the transportation of supplies. A shipment of two carloads proved so profitable that mining was vigorously begun and the first thousand tons yielded a profit of more than $25,000. The mine has now been opened to a depth of some 400 ft., and the owners have contracted with the Montana Ore Purchasing Co. of Butte City, Mont., now erecting a smelter near the mine, to furnish not less than 100 tons per day. The new smelter is expected to be finished and ready for work by the 1st of March next. Its site is at Trail Landing on the Columbia river, seven miles from the mine.

The War Eagle mine, of which your readers have doubtless heard, is on a parallel vein, a short distance above the Le Roi. Like the Le Roi the first assays were no criterion of its value, but within a year it has paid $132,000 in dividends.

The Josie, another mine to the west of the Le Roi and War Eagle, has been shipping ore all summer.

These and other claims are on the same hill (Red Mountain.)

In the immediate vicinity are situated the 'Centre Star,' 'Iron Mask,' 'Silverine,' 'Evening Star,' 'Monte Cristo,' 'Iron Horse,' 'Great Western,' and other claims, upon which more or less development has been done during the past summer with promising results.

The 'Iron Horse' and 'Evening Star' have shipped ore varying from $25.00 to $40.00 per ton.

East of Monte Cristo mountain, where these claims are situated, is the Columbia mountain. The "Georgia," "Columbia," "Kootenai" and many others are located here and have made experimental shipments. The gold is sometimes free milling, but more frequently is found in combination with iron and copper. West of Red Mountain many promising claims are being developed. About one mile south is the South Belt. Many locations made there since May are improving rapidly. The "Crown Point," "Robert Lee," "Maid of Erin" and "Homestake," are waiting for snow in order to begin shipping. The above does not include all the mines, only the most prominent. The veins trend north-east and south-west and dip to north and can be traced on the surface by an iron capping which must be worked through before value is found. This cap in places has the appearance of rich ore, but rarely gives value and varies in thickness. Thus in some mines no ore of value is found for 50 to 100 ft. in depth.

The ore is a sulphide containing something like 10 to 60 per cent. iron per ton, 2 to 20 per cent. copper; trace to $200.00 in gold per ton, trace to 190 oz. silver.

The camp is accessible at all seasons from the Canadian Pacific Railway, via. Columbia River to Trail Landing seven miles thence by stage. Work is now being pushed on the 13 miles of narrow guage railway from Trail Landing to the shipping mines, and it is expected that the line will be open in March.

With the smelter reducing ore and railroad to transport same, we look forward to rapid development after midwinter, as many of the claims with ore on dumps which cannot afford to ship at present rates, will then do so in sample lots of a few tons to determine value.

I am,
Yours, etc.,
A PROSPECTOR.

Trail Landing, B.C., 2nd Dec., 1895.

Mica Mining in British Columcia.

To the Editor:

SIR,—Notwithstanding that mining heretofore, as at present, formed the most important of our industries, the fact remains that the mineral resources of this portion of the Dominion are only now becoming rightly understood. This is true in respect of all the known minerals of this Province. The particular mineral to which it is my intention to call the attention of your readers is the muscovite, or white mica, and the extensive area over which it occurs in the Province of British Columbia in that region known as the Canoe River and Tete Juane Cache. In the summer of 1894 I visited the mines with guides and found high in the summit of a range of mountains, divided from the Rockies and the Selkirk ranges by the Canoe and Fraser rivers valley (rightly the gold range, as it is the same range of mountains extending to the northwest and embracing the Cariboo gold fields), numerous quartz veins of different thickness, running parallel from northeast to southwest, liberally impregnated with mica in crystals of various sizes. At Canoe river the most of these were capped with black or biotite mica to the depth of from 4 to 6 inches, connecting in some cases with the white mica which comes in immediately at that depth. The mica taken, though in small crystals as yet, is of a first class quality, tough and flexible. At Tete Juane Cache, 20 miles further north, where we have done the most work so far, the same number of veins are visible, although not so easy of access from the camp which is generally made at the edge of timber line. I was there only a few days last year before snow came, consequently had not the time to satisfy myself how far south in the direction of Canoe river these veins could be traced. This, however, my visit during the past summer has cleared up. I arrived at the mines at a little earlier date than the previous year. After I had my men fairly at work I started on a tour of investigation, as up to that time I was not quite satisfied with the spot I was working, for, though it was producing large crystals, they were more or less defective, checked and stained, and I could not trace the deposit further than about 100 yards, while all the other veins could be traced for miles. I therefore ascended the cliff immediately above our workings and there, under an immense glacier, lay exposed the break from which that immense body below had some centuries ago broken loose and slid to where it is now being mined. It is fair to estimate (judging the output at present, and the immense body of mineral exposed at the break) that there are thousands of tons of mica in the fault. The vein can be reached from a point to the west of the mountain. This vein, which runs along and nearly the very top of the mountain, is the main lead; the others can be recognized as leaders although carrying a great deal of mica. Continuing my investigations to the south, I found the most of the underlying veins outcropping all the way for about ten miles. The mica shows itself in fair sized blocks and from the fact of it not being disturbed it is like that of Canoe river, firm, tough and flexible. I took out a small crystal with my pole-pick from the edge of the quartz. Though found in an exposed position, it shows very little stain, and the cleavage is excellent. The position of this new discovery, owing to its accessibility, is of all the locations the best in this vicinity to handle cheaply. I made two locations at this point of 1,300 feet square each. Altogether my operations for the past summer were entirely satisfactory, having packed out in crates 1,500 lbs. of mica. Time and men were limited to such an extent as to oblige the bringing of the cargo in the rough, but there are crystals weighing as high as 140 lbs. in the solid. The entire lot will cut from 4 x 4 in. to 12 x 20, allowing for waste and discoloration. I estimate the net clean clear mica at between 900 to 1,000 lbs. As will be remember, I stated last fall that it was almost a matter of impossibility for anyone to exaggerate the extent and possibilies of these mica bearing areas. My investigations during the past summer have satisfied me still further as to the correctness of that assertion, as I have almost connected the two previous localities of 20 miles apart, by my discovery of this year. I am pleased to be able to state that negotiations are now pending for the transfer of the locations at Canoe River and those at Tete Juane Cache to a company of American capitalists at Chicago, which will also, it is expected, take the product.

(Signed) JOHN F. SMITH.

LOUIS CREEK, Kamloops, B.C., 9th Dec.

MINING IN NOVA SCOTIA.

(From our own Correspondent.)

We recently paid a visit to the Indian Post gold mine, Lunenburg Co., which is being reopened after a rest of nearly 30 years. The vein, which is from five to seven feet wide, was looking very well, the gold being very fine and evenly shot through the quartz. The old ten stamp mill is being fitted up, and new amalgamating tables 10 feet in length, will replace the old ones, which were only four feet long. It is expected that crushing will be started about the middle of December, and unless our judgment of the ore is at sea, the first yield will be an eye-opener, although to the uneducated eye the quartz does not appear to be anything out of the ordinary. A neat and very clean miner's lodging has been erected, together with other buildings. The prospect looks very promising and we hope this district will be in operation for some time to come.

The North Brookfield mine is continuing its splendid record. Mr. W. L. Libby was in town with 394 oz. of gold. This is particularly good as there were two or three days' stoppage for repairs.

The Modstock mine has been bonded to Mr. R. Dickson, one of the owners, who s trying to interest New York capital in it. The mine was recently reported on by an expert from New York.

The New Halifax Gas Co. has chosen as a site the old penitentiary. The stock in this company is held for the most part by the same people as the Dominion Coal Co. It is, we are informed, the thin end of the wedge for a neat little metallurgical plant in Halifax. The illuminating gas is really to be a by-product in the manufacture of coke for foundry purposes, and an attempt will be made to manufacture a high class coke, with a view to replacing hard coal for household use. The company are starting on a sound basis, and are putting up a plant to save all possible by-products. It is not improbable that at a later date iron smelters will be added to this plant. This industry will of course open up a considerable amount of trade for the Dominion Coal Co. The only regrettable part is that the site chosen is in the midst of one of one of the best residental parts of Halifax, and it is consequently meeting with a considerable amount of local opposition.

The plans for the erection of a reduction works at the Coxheath copper mine are to be ready by the middle of February, when it is proposed to start on the erection of the same with all possible speed.

That good old district of Molega is once more coming to the front. Herbert Dixon has a lot of very good looking quartz on deck and has started crushing. The Boston company are also doing a considerable amount of work on their property in this district.

Notwithstanding the very emphatic heading over the gold returns for the nine months ending Sept. 30th, 1895, published in our last issue, complaints have been made to us that we have not given the full returns, the complainants thinking our returns were for the year ending Sept. 30th. We therefore wish it to be distinctly understood that those returns were for nine months and that we intend giving the full returns for the year ending Dec. 31st, 1895, in a later issue.

Since penning the note in our last issue that the returns of gold for the Provincial mining year were below the average, further returns have been made, which we are pleased to say have raised the figures above those of last year.

A new find of heavy nuggety gold quartz is reported from the Tangier district.

We had a call recently from Mr. J. D. Copeland, who has a genuine grievance in the bad state of the roads in the Forrest Hill district. He informed us that the hauling of boards from the corner of the Guysborough road to the Modstock mine, a distance of three miles, cost him $10 per thousand. This matter of bad roads is affecting all the mines in the district. Mr. Copeland's is by no means an isolated case; we have had complaints from other mine owners. The exhorbitant figures paid for the haulage of supplies considerably increases the expenses of mining and is undoubtedly a genuine grievance which requires looking into.

The new pumping and hoisting gear on the Plough lead development work is completed and operations, which have been at a standstill for some time past, have been once more resumed. Recent developments have satisfied the company that they are on the right track to recover the continuity of the rich strike. The development work is in the hands of Mr. George Stuart.

At Goldenville Mr. J. A. Fraser, although confining himself almost entirely to development work has been raising sufficient gold to more than cover expenses. The McArthur-Partridge mine in this district is still keeping up a steady yield, while the Wentworth mine, which produced so largely and profitably in the early part of the year and which has recently been shut down ostensibly for repairs, has started up again. It is rumored that a former trusted employee, on a bed of sickness and fearing the approach of death, made such extraordinary divulgences and substantial restitution that fresh confidence was given to the much-wronged company.

Fifteen-Mile stream is again to the front with 300 oz. of gold for the month, notwithstanding delays from unusually heavy rains; in fact these have been felt through the whole of the Province.

Some 20 men are at work at Crow's Nest mine under Messrs. Hood & Weston, who are contemplating purchasing the property. A Rand drill has been started to push the underground exploitation.

The following item from the "Iron and Coal Trades Review" will be of interest to Nova Scotian iron manufacturers:—"Under the lee of a big demand which keeps up the United States, the manufacturers of Canadian iron are doing a good business. Beyond question the present season is the best one the Nova Scotia furnace men have ever had. In their early days they were kept back by the competition of British irons which was often carried as ballast across the Atlantic. When at last the British irons began to give ground in the interior, especially in Ontario, it was not before the Nova Scotia brands they retreated. A new competitor of the latter, United States iron, was capturing the Ontario market. With American irons in Ontario and British irons to struggle against in Quebec and the Maritime Provinces, the Nova Scotian iron industry found the problem of existence hard enough. Finally British iron practically withdrew. Then a more spirited contest was made with American iron by that of New Glasgow, Londonderry and Ferrona furnaces, which, having captured the Montreal trade from the British, was in a better position to dispute that of Ontario with the United States. But the extraordinary depression in American iron prices told against the Nova Scotians; at last prices went up in the United States. All iron made there was wanted at good prices at home. The American iron withdrew, and though stocks in Ontario were full when the advance came there has been time since for them to run down and make room for the absorption of several thousands of tons of the home article."

The Golden Lode mine produced 323 oz. 2 dwt. of gold last month, the quartz running about 11 oz. per ton.

The coal deposits of Broad Cove, C.B., have recently been examined by Mr. Fell, who has been sent out by the well known firm of Messrs. Bainbridge & Seymour, in the interest of British capitalists.

Among our illustrations this month we reproduce two excellent photographs of the fine new milling plant built last year by Mr. Saunders for his mine at Caribou. Both mine and mill are equipped with the latest and most approved machinery and appliances for economic production.

The autumn meeting of the Mining Society was one of the most interesting held since its organization. An excellent series of sessions concluded with a quiet dinner at the Queen's. A full report of the proceedings is, as usual, given in the REVIEW this month.

PROVINCE OF NOVA SCOTIA.

Leases for Mines of Gold, Silver, Coal, Iron, Copper, Lead, Tin

—AND—

PRECIOUS STONES.

TITLES GIVEN DIRECT FROM THE CROWN, ROYALTIES AND RENTALS MODERATE.

GOLD AND SILVER.

Under the provisions of chap. 1, Acts of 1892, of Mines and Minerals, Licenses are issued for prospecting Gold and Silver for a term of twelve months. Mines of Gold and Silver are laid off in areas of 150 by 250 feet, any number of which up to one hundred can be included in one License, provided that the length of the block does not exceed twice its width. The cost is 50 cents per area. Leases of any number of areas are granted for a term of 40 years at $2.00 per area. These leases are forfeitable if not worked, but advantage can be taken of a recent Act by which on payment of 50 cents annually for each area contained in the lease it becomes non-forfeitable if the labor be not performed.

Licenses are issued to owners of quartz crushing mills who are required to pay Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at $19 an ounce, and on smelted gold valued at $18 an ounce.

Applications for Licenses or Leases are receivable at the office of the Commissioner of Public Works and Mines each week day from 10 a.m. to 4 p.m., except Saturday, when the hours are from 10 to 1. Licenses are issued in the order of application according to priority. If a person discovers Gold in any part of the Province, he may stake out the boundaries of the areas he desires to obtain, and this gives him one week and twenty-four hours for every 15 miles from Halifax in which to make application at the Department for his ground.

MINES OTHER THAN GOLD AND SILVER.

Licenses to search for eighteen months are issued, at a cost of thirty dollars, for minerals other than Gold and Silver, out of which areas can be selected for mining under lease. These leases are for four renewable terms of twenty years each. The cost for the first year is fifty dollars, and an annual rental of thirty dollars secures each lease from liability to forfeiture for non-working.

All rentals are refunded if afterwards the areas are worked and pay royalties. All titles, transfers, etc., of minerals are registered by the Mines Department for a nominal fee, and provision is made for lessees and licensees whereby they can acquire promptly either by arrangement with the owner or by arbitration all land required for their mining works.

The Government as a security for the payment of royalties, makes the royalties first lien on the plant and fixtures of the mine.

The unusually generous conditions under which the Government of Nova Scotia grants its minerals have introduced many outside capitalists, who have always stated that the Mining laws of the Province were the best they had had experience of.

The royalties on the remaining minerals are: Copper, four cents on every unit; Lead, two cents upon every unit; Iron, five cents on every ton; Tin and Precious Stones; five per cent.; Coal, 10 cents on every ton sold.

The Gold district of the Province extends along its entire Atlantic coast, and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the Counties of Cumberland, Colchester, Pictou and Antigonish, and at numerous points in the Island of Cape Breton. The ores of Iron, Copper, etc., are met at numerous points, and are being rapidly secured by miners and investors.

Copies of the Mining Law and any information can be had on application to

THE HON. C. E. CHURCH,

Commissioner Public Works and Mines,

HALIFAX. NOVA SCOTIA.